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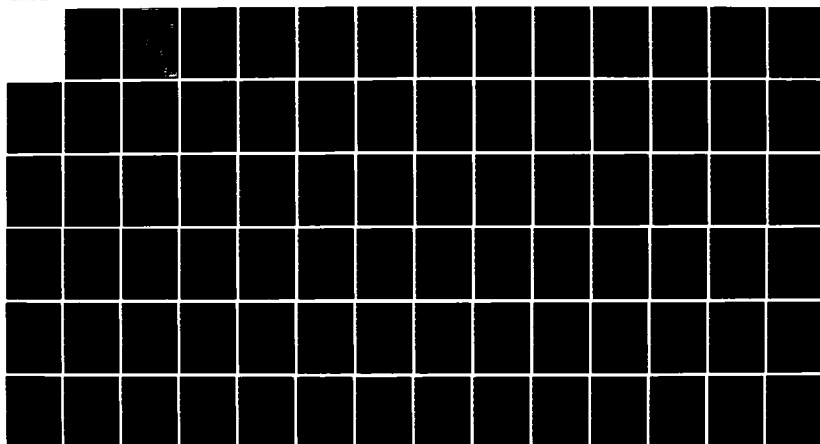
A COMPUTER SYSTEM FOR GENERATING SINGLE AND DOUBLE
SAMPLING PLANS FOR ATT. (U) FLORIDA UNIV GAINESVILLE
DEPT OF INDUSTRIAL AND SYSTEMS ENGIN..
K W BEITLER ET AL. AUG 84 RR-84-35

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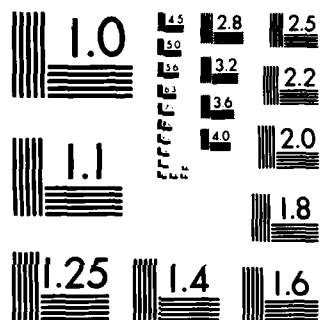
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A COMPUTER SYSTEM FOR GENERATING SINGLE AND DOUBLE
SAMPLING PLANS FOR ATTRIBUTES DATA

Research Report No. 14-35

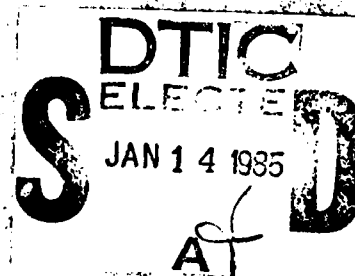
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RESEARCH REPORT



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ABSTRACT

Average Sample Number (ASN),

This study brings together the programs developed in three previous reports into a unified sampling system. One segment contains the single and double sampling plans of MIL-STD-105D along with subroutines that evaluate the normal, tightened and reduced plans including switching rules. Output includes system OC curves, and *Average Fraction Inspected (AFI)* ~~ASN~~, ~~AQI~~, and ~~AFI~~ curves in either graphical or tabular form. Another segment derives single and double sampling plans to satisfy two points designated on the OC curve. An algorithm is employed which seeks to minimize the ASN at a designated Acceptable Quality Level (AQL). The third segment is designed for use when rectifying inspection is employed. It derives single and double sampling plans based on one point on the OC curve, either the process average or a specified AQL value, intended to not exceed a specified *Average Outgoing Quality Limit* ~~AQL~~ and minimizing the AFI at the process average or specified AQL. Programming is written in FORTRAN IV and development was on a VAX 11-750 computer.

Transmission for	
CRASH	
1	
<i>Letter on file</i>	
303	
for	
1	
A1	



INTRODUCTION

This report brings together the results of three previous studies dealing with acceptance sampling using attributes data. The previous studies dealt with single and double acceptance sample plans. The first involved a computerized version of MIL-STD-105D. The second dealt with the design of double sampling plans in cases where rectifying inspection is not employed. An objective function is introduced which minimizes the average amount of inspection when the process is operating at what is considered an acceptable level. The third study assumes that rectifying inspection is planned based on some specified Average Outgoing Quality Limit and has as an objective function the minimization of inspection when the process is operating at an acceptable level. All computer programming is in ANSI FORTRAN IV and the programs were developed on a VAX 11-750 computer utilizing the VMS operating systems.

DESCRIPTION OF THE PROGRAM SEGMENTS

List of Program Segments

The programming system is composed of seven main segments. Each performs a specific activity with respect to the operation of the system or contains the code for executing the user's choice of sampling plans. These include:

1. Finding and evaluating MIL-STD-105D single and double sampling plans as a system of normal, tightened, and reduced inspection plans.
2. Deriving sampling plans to minimize the Average Sample Number (ASN), or average sample size;
3. Deriving sampling plans to minimize the Average Fraction Inspected (AFI) based on a specified Average Outgoing Quality Limit (AOQL).

The program segments are:

- QUALITY.COM A command file that compiles and links the program files into an executable file, QMAIN.EXE.
- QMAIN.FOR The main program control file from which are called the three sampling plan programs.
- QMIL.FOR The program containing MIL-STD-105D sampling plans and the analysis package.
- QASN.FOR The program for finding single and double sampling plans based on minimizing the ASN.
- QAFI.FOR The program for finding single and double rectifying inspection sampling plans based on minimizing the AFI.
- PROBS1.FOR A program for calculating probabilities, binomial or Poisson, for single sampling plans. It is used by QASN.FOR and QAFI.FOR.
- PROBD1.FOR A program for calculating probabilities, binomial or Poisson, for double sampling plans. It is used by QASN.FOR and QAFI.FOR.

Program Segment QMIL.FOR

The program QMIL.FOR contains all of the single and double sampling acceptance plans from MIL-STD-105D for normal, tightened, and reduced inspection. They are organized such that the user goes through identically the same procedure as if the Standard were being used. First, an Inspection Level is entered (Special Levels S-1 through S-4 or General Levels I, II, or III) followed by lot or batch size. This leads the program to the selection of the appropriate sample size code letter. The required AQL (Acceptable Quality Level) is entered next. This value must be one of the prescribed values in the Standard. Any other value will lead to extraneous and undesired results. Those values are, expressed in percent defective or defects per 100 units:

0.010, 0.015, 0.025, 0.040, 0.065, 0.10, 0.15, 0.25, 0.40, 0.65,
1.0, 1.5, 2.5, 4.0, 6.5, 10, 25, 40, 65, 100, 150, 250, 400, 650, 1000.

Once a system of sampling plans has been obtained, the user is given the option of having the system analyzed. Output of the analysis may be either in tabular or graphical form. In tabular form, a range of values of p for which the calculations are to be made must be entered. If the user has no idea of the range of p required, it may be desirable to first obtain graphical output and then select the values of p for which accurate results are to be obtained. One caution with respect to graphical output is necessary at this point. In order to obtain clear, easily readable graphical output, the printer unit must be capable of and set on condensed printing. Graphical output uses more space than the standard 80 column pica type font allows. Hence, when restricted to 80 columns, two lines are used for each actual line of output.

Output of the analysis in tabular form appears as follows:

1. The value of p for which the calculation was made.
2. The probability of acceptance.
3. The average sample size (ASN).
4. The average outgoing quality (AOQ).
5. The average fraction inspected (AFI).

Item 3 applies only to those items in samples. Items 4 and 5 apply only if rectifying inspection is being employed; i.e., that all rejected lots are screened of defective units (defects) and are repaired/replaced in the lot in acceptable condition.

The graphical output provides the same information except that curves of the characteristics are plotted rather than numerical values printed. Because of limitations on the type of graphical output, the tabular output will be more accurate.

Analytical results of the program will not correspond exactly with those shown in MIL-STD-105D because the program treats the normal, tightened, and reduced inspection plans, along with the switching rules for changing from one

to the other, as a system of plans and analyzes the entire system rather than each plan individually. The system is analyzed as a Markov chain. Steady state probabilities of being in each of a series of states under normal, tightened and reduced inspection are calculated for each value of p in the effective range of the OC curve. These probabilities are then combined to give probabilities of being in normal, tightened and reduced inspection. From these values are calculated the probabilities of acceptance of lots or batches, the OC curve points, the ASN, AFI, and AOQ. As is the case in the Standard itself, each calculation assumes that lots are being formed from a process generating a constant value of p , i.e., a process in statistical control.

Details of the models and procedures are contained in reference (1).

Program Segment QASN.FOR

This program segment enables the user to design custom double sampling plans to minimize the average sample size based on two points on the operating characteristic curve. In the process, it also specifies the minimum single sampling plan that meets the OC curve requirements. The selection of plans based on ASN minimization are intended for use when rectifying inspection either is not or can not be used. Inputs to this program segment include a choice between the binomial and Poisson distributions for calculating probabilities of acceptance, the two specified points on the OC curve, a seed value for the sample size of the equivalent single sampling plan, and a value for the rejection number on the first sample of the double sampling plan.

The output consists of the minimum sampling plan, a series of double sampling plans, the double sampling plan found to have the minimum ASN evaluated at the input good quality level, and the maximum value for the ASN for the $R1$ value originally input to the program.

The two points designated for the OC curve are related to the traditional Producer's and Consumer's risks. The program uses P_0 to designate the producer's maximum acceptable quality level (an AQL as defined in MIL-STD-105D) or process average with the minimum probability of acceptance set at $(1 - \alpha)$. In this case, α is the designated maximum producer's risk. The quality level P_1 is the designated consumer's maximum acceptable quality level (RQL, or rejectable quality level) with a maximum probability of acceptance of β . In this case, β is the designed maximum Consumer's risk. The equations are of the form:

$$L(P_0) \geq 1 - \alpha$$

$$L(P_1) \leq \beta$$

where $L(P)$ is the likelihood function (probability of acceptance formula) for the particular sampling plan being analyzed.

With these two equations alone, an infinite number of sampling plans, single and double, exist which satisfy the inequality constraints. A reasonable choice from among that group is that plan which provides for minimum inspection on the average. Thus an objective function is introduced that minimizes the ASN when the process is operating at or below the AQL. This value is designated ASN or $ASN(P_0)$ on the computer output.

Users familiar with MIL-STD-105D will remember that double and multiple sampling plans in that standard are designed such that their respective ASN's never exceed the sample size of the single sampling plan with the same OC curve. The capability of establishing this additional constraint has been provided for in this program segment. As part of the output, the user receives the maximum value of the ASN reached for each plan analyzed. This value is designated ASN_{MAX} . (The program searches the ASN function as a function of p and outputs that value.) Thus the user may search through the

program output for those plans with a ASNMAX less than or equal to the minimum single sampling plan and select from them the plan with the minimum ASN(P0). It is worth noting at this point that, in most of the plans explored in the development of this segment, addition of this constraint did not result in changing the optimal choice.

Reference (2) presents detailed findings and a full description of the program's development.

Program Segment QAFI.FOR

This program segment develops single and double sampling plans which meet a specified Average Outgoing Quality Limit (AOQL). They are intended for use only when rectifying inspection (100% inspection of the balance of rejected lots) is employed. Calculations assumes that rectifying inspection is 100% effective and that the binomial distribution provides sufficient accuracy in calculating probabilities of acceptance.

Inputs to this segment include a Producer's Risk Point ($P_0, 1-\alpha$), the desired AOQL (designated AOQL*), and the lot or batch size. Outputs include the minimum single sampling plan satisfying the constraints, a series of double sampling plans all of which satisfy the AOQL constraint, and that plan which satisfies the constraints and minimizes the Average Fraction Inspected (AFI) when the process is operating at the quality level P_0 . The quality level P_0 may be interpreted either as an AQL value as defined in MIL-STD-105D or as a process average as defined and employed in the Dodge-Romig tables. As in the Dodge-Romig tables, the rejection numbers on the first and second samples, R_1 and R_2 , are set at the second acceptance number, C_2 , plus one.

The objective function and constraint equations are of the form:

minimize $AFI(P_0)$

subject to:

$$L(P_0) > 1 - \alpha$$

$$AOQL \leq AOQL^*$$

$$R_1 = R_2 = C_2 + 1$$

First, the program finds the minimum single sampling plan satisfying the likelihood function and AOQL constraints. This information is used internally to assist in setting bounds for the algorithm that solves for the double sampling plans. Then the algorithm shifts to seeking the double sampling plan satisfying the constraints. In its search, a number of plans are found and it is from this group that the plan that minimizes $AFI(P_0)$ is selected. Output includes the sample sizes N_1 , and N_2 , acceptance numbers C_1 and C_2 , and the $AFI(P_0)$, designated simply as AFI .

Reference (3) provides a complete description and analysis of the development and operation of the algorithm and program.

PROGRAM OPERATING INSTRUCTIONS AND OUTPUT

Initializing the Program

In the following instructions, user inputs are in capital letters. A backward arrow (+) indicates a carriage return.

Program initialization begins by entering:

@QUALITY+

This instruction executes the command file (QUALITY.COM) which compiles and links the program files into a single executable file (QMAIN.EXE). If QMAIN.EXE has been created and exists in the file, this step may be eliminated.

Once QMAIN.EXE has been created, the user enters:

RUN QMAIN+

This command starts program execution. Very shortly the following message will appear on the terminal screen:

```
WHAT DO YOU WISH TO DO?
1-DERIVE SAMPLING PLANS TO MINIMIZE ASN
2-DERIVE SAMPLING PLANS TO MINIMIZE AFI
3-EVALUATE MIL-STD-105D SAMPLING SCHEME
4-EXIT THIS PROGRAM
```

Entering the number for your selection followed by a carriage return transfers program control to QASN.FOR, QAFI.FOR, QMIL.FOR, or the computer operating system. These instructions are repeated after each run of the program until the user exits with instruction (4).

Running QASN.FOR

Entering number 1 from the main transfers program control to QASN.FOR, the program for generating double sampling plans designed to minimize the ASN at quality level P0. What follows is the menu QASN.FOR.

The first question in this menu asks you to name an output file (8 alphanumeric characters or less).

WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?

User enters a name and +.

Subsequent questions are:

```
CODES FOR SELECTING APPR. PROB. DIST.
BINOMIAL                      =1
POISSON                       =2
```

User then enters the appropriate code. The Poisson uses the intensity parameter $\lambda = np$ in terms of defects per 100 units.

```
SELECT
SAMPLE PLANS ONLY = 1
ASN VALUES ONLY = 2
OR BOTH = 3
```

The most useful of these choices is to enter 3. Entering 1 produces an output of a large number of sampling plans all of which meet the criteria for the two points on the OC curve. Output includes the values of C_1 , C_2 , and N_1 , the range over which N_2 may operate, and the probabilities of acceptance at P_1 and P_0 , respectively. Entering 2 results in the production of a large number of plans satisfying the OC curve constraints and lists values of ASN_{MAX} and $ASN(P_0)$. When 3 is entered, the optimization algorithm is called in thus the output is limited to those plans which were considered candidates for the optimum. Output includes C_1 , C_2 , and N_1 , the effective range for N_2 , and the ASN_{MAX} and $ASN(P_0)$ when the smallest value of N_2 is used. It then selects the global optimum plan for the input value of R_1 .

INPUT ALPHA	User enters the Producer's Risk, α +
INPUT BETA	User enters the Consumer's Risk, β +
INPUT P_0	User enters P_0 +
INPUT P_1	User enters P_1 +

INPUT A SEED FOR THE SINGLE SAMPLING NO.
IF NO SEED AVAILABLE ENTER ZERO AS THE SEED VALUE

If the user has some idea what the sample size will be for the single sampling plan satisfying the OC curve requirements, a conservative value somewhat lower than that number may be entered. This option is useful only when the sample size is known to be large and user wishes to save some time. Its use may lead to nonoptimal results if the seed value is larger than the optimal value.

INPUT A VALUE FOR ($R_1 - C_2$)
IF $R_1 = C_2$ THEN THE VALUE WOULD BE 0
IF $R_1 > C_2$ THEN THE VALUE WOULD BE A POSITIVE NO.
IF $R_1 < C_2$ THEN THE VALUE WOULD BE A NEGATIVE NO.

This option allows the user to vary the value of R_1 in the search for optimality. Each run of the program provides the optimal plan for a given selected value of R_1 .

From this point on the program takes over generating the desired output.

Running QAFI.FOR

Entering 2 from the main menu transfers control to QAFI.FOR, the program segment for finding rectifying inspection plans satisfying AOQL and AQL constraints while minimizing the AFI at the AQL level. The menu for QAFI.FOR leads the user as follows:

ENTER VALUE OF ALPHA	User enters Producer's Risk, α
ENTER VALUE OF P0	User enters quality level P0
ENTER AOQL VALUE	User enters AOQL (in percent)
ENTER LOT SIZE	User enters lot size

The program then proceeds to generate a series of sampling plans for which $R1 = R2 = C2 + 1$ and selects the optimal plan from among this group. Output includes the values of C1, C2, N1, N2, and AFI(P0), respectively, and the optimal plan.

Running QMIL.FOR

Entering 3 from the main menu transfers control to QMIL.FOR, the program segment for finding single and double sampling plans from MIL-STD-105D and, at the user's discretion, evaluating the resulting normal, tightened and reduced inspection plans as a system. Output of the evaluation may be either graphical or tabular. The menu for this segment is as follows:

WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?

User enters a name for the output file (8 alphanumeric characters or less).

ENTER INSPECTION LEVEL IN QUOTATION MARKS
E.G.,; SPECIAL: 'S1', 'S2', 'S3', 'S4'
GENERAL: '1', '2', '3'

User enters the appropriate code followed by +. A note of caution here. Any error on entry will cause program failure and automatic exit. Depending on the terminal being used, it may be necessary to use apostrophe marks rather than quotation marks surrounding the entry.

ENTER LOT SIZE: User enters lot size+

ENTER AQL IN PERCENT. REMEMBER, ONLY A STANDARD
AQL IS ALLOWABLE User enters AQL +

DO YOU WANT SINGLE ('S') OR DOUBLE ('D')
SAMPLING PLANS; (NOTE: ENTER S OR D IN QUOTES).

The same caution for entry of the inspection level applies here as well.

The program then proceeds to select the desired sampling system from the Standard. Once the plans are displayed, user is asked:

DO YOU WANT SCHEME EVALUATION..?
IF YES ENTER.....1
IF NO ENTER.....2

If the answer to this question is no, program execution stops and the user is presented with the main menu. If the answer is yes, execution continues with:

DO YOU WANT A TABLE OR A GRAPH FORMAT?
FOR GRAPH.....ENTER: 1
FOR TABLE.....ENTER: 2

Entering 1+ for graphical format results in the output of a plot of the OC curve, the ASN curve, the AOQ curve, and the AFI curve. (Naturally, the AOO and AFI curves have no meaning unless rectifying inspection is intended.) In order for these curves to be readable, the printer must be capable of and set on compressed printing. The horizontal scale of each of the graphs (probability scale in the case of the OC curve) requires more than 80 columns. Thus, if an attempt is made to print graphs in standard 80 column format, the printing will occur on two consecutive lines making the whole thing look very weird.

When 2+ is entered, i.e., a tabular format is requested, the computer returns with the following questions:

SPECIFY THE NUMBER OF FRACTION DEFECTIVE VALUES..

The user must enter the number of values of p for which the equation is to be made.

ENTER THE FRACTION DEFECTIVE VALUE(S).
(PUT A COMMA BETWEEN VALUES.).....

The user then enters the values as fractional quantities, not percents. In this case the output is a table containing p , $P(A)$, ASN , AQ and AFI , respectively. It may be useful to obtain a graphical output on a first run to obtain the effective range of p required for a good tabular output. Naturally, the table is more accurate than is the graph.

REFERENCES

1. Siddiqi, Azmat H. and R. S. Leavenworth, An Interactive Computerized Approach for Tabulating and Evaluating MIL-STD-105D. ISE Research Report No. 84-30, August, 1984.
2. Rangarajan, R. W., K.W. Beitler, and R. S. Leavenworth. Developing Double Sampling Plans for Attributes to Meet Sample Size Criteria. ISE Research No. Report 84-32, August, 1984.
3. Walker, Jo Ellen and R. S. Leavenworth. Designing Optimal AQL Sampling Plans - a Computerized Approach. ISE Research Report No. 84-1, May, 1984.

APPENDIXES

Appendix A contains several example runs for each of the program segments.
The entire program is listed in Appendix B.

APPENDIX A
Program Example Runs

Example 1 QASN.FOR

WHAT DO YOU WISH TO DO?

- 1-DERIVE PLANS TO MINIMIZE ASN
- 2-DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE

1
WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?
PR1

CODES FOR SELECTING APPR. PROB. DIST.

BINOMIAL =1
POISSON =2

1
SELECT
SAMPLE PLANS ONLY =1
ASN VALUES ONLY =2
OR BOTH =3

3
INPUT ALPHA

.05
INPUT BETA

.1
INPUT P0

.015
INPUT P1

.05
INPUT A SEED FOR SINGLE SAMPLING NO.

IF NO SEED AVAILABLE ENTER ZERO AS THE SEED VALUE

0
INPUT A VALUE FOR (R1-C2)

IF R1=C2 THEN THE VALUE WOULD BE 0

IF R1>C2 THEN THE VALUE WOULD BE A POSITIVE NO.

IF R1<C2 THEN THE VALUE WOULD BE A NEGATIVE NO.

1

ALPHA =0.0500 BETA =0.1000
P0 =0.0150 P1 =0.0500

REJECTION NO. OF FIRST SAMPLE (R1) = C2+(1)

SINGLE SAMPLING PLAN
ACCEPTANCE NO. (C) = 6
LOWER BOUND ON N (NS) = 209
UPPER BOUND ON N (NL) = 220

DOUBLE SAMPLING PLANS

FOR C1= 0 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
59	166	166	212.4477	156.9425
60	164	165	211.5781	157.7704

DOUBLE SAMPLING PLANS

FOR C1= 1 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
89	139	139	201.8087	142.6555
90	136	137	200.3593	143.2139

DOUBLE SAMPLING PLANS

FOR C1= 2 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
115	115	116	191.8224	143.4053
116	112	114	190.8090	144.1031

DOUBLE SAMPLING PLANS

FOR C1= 3 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
139	94	96	186.4893	153.2870
140	91	94	185.9685	154.0707

DOUBLE SAMPLING PLANS

FOR C1= 4 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
161	82	82	188.3876	167.9648
162	76	80	187.3810	168.5728

DOUBLE SAMPLING PLANS

FOR C1= 5 C2= 6

(N1)	(N2S)	(N2L)	ASNMAX	ASN
184	75	87	196.2480	186.8779
185	57	80	194.3076	187.2266

SINGLE SAMPLING PLAN

ACCEPTANCE NO. (C) = 7

LOWER BOUND ON N (NS) = 234

UPPER BOUND ON N (NL) = 266

DOUBLE SAMPLING PLANS

FOR C1= 0 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
50	226	228	265.0669	169.8499
51	220	226	260.3219	169.2180
52	215	225	256.5318	169.0233
53	211	223	253.6964	169.2884

DOUBLE SAMPLING PLANS

FOR C1= 1 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
81	198	202	252.9615	148.9811
82	192	200	248.7259	148.9649
83	187	198	245.3612	149.2348

DOUBLE SAMPLING PLANS

FOR C1= 2 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
108	178	181	242.3765	147.3077
109	170	179	237.3196	147.2064
110	164	177	233.7746	147.5018

DOUBLE SAMPLING PLANS

FOR C1= 3 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
134	157	164	231.0574	156.3438
135	147	162	225.8645	156.3163
136	139	160	221.9088	156.5329

DOUBLE SAMPLING PLANS

FOR C1= 4 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
159	141	156	224.8282	171.6242
160	125	152	218.3522	171.4111
161	115	149	214.6785	171.7019

DOUBLE SAMPLING PLANS

FOR C1= 5 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
184	117	181	220.1528	190.2280
185	96	172	214.6608	190.2104
186	85	165	212.2600	190.7030

DOUBLE SAMPLING PLANS

FOR C1= 6 C2= 7

(N1)	(N2S)	(N2L)	ASNMAX	ASN
209	75	266	220.3671	210.8894
210	57	266	218.6382	211.4632

GLOBAL MINIMUM ASN(P0)= 142.66

CORRESPONDING N1 = 89

CORRESPONDING N2S = 139

CORRESPONDING C1 = 1

CORRESPONDING C2 = 6

Example 2 QAFI.FOR

WHAT DO YOU WISH TO DO?

- 1-DERIVE PLANS TO MINIMIZE ASN
- 2-DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE

2

ENTER VALUE OF ALPHA

.05

ENTER VALUE OF P0

.015

ENTER AOQL VALUE

.02

ENTER LOT SIZE

2000

ALPHA= 0.050000

P0= 0.015000

AOQL= 0.020000

N= 2000

*** SINGLE SAMPLING PLAN ***

NS=120

C= 4

AFI(P0)=0.093093

** DOUBLE SAMPLING PLANS **

C1	C2	N1	N2	AFI
0	4	29	91	0.056349
1	4	55	66	0.060894

C1	C2	N1	N2	AFI
0	5	28	120	0.051799
1	5	55	93	0.054159

C1	C2	N1	N2	AFI
0	6	28	147	0.050792
1	6	55	120	0.050957

C1	C2	N1	N2	AFI
0	7	28	174	0.051735
1	7	55	147	0.049855
2	7	82	121	0.056638

C1	C2	N1	N2	AFI
0	8	28	201	0.053922
1	8	55	174	0.050058
2	8	82	148	0.055690

SAMPLING PLAN MINIMUMS

C1= 1 C2= 7
N1= 55 N2=147
MINIMUM AFI=0.049855

Example 3 QMIL.FOR

WHAT DO YOU WISH TO DO?

- 1-DERIVE PLANS TO MINIMIZE ASN
- 2-DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE

3

ENTER INSPECTION LEVEL IN QUOTATION MARKS

E.G.; SPECIAL : 'S1', 'S2', 'S3', 'S4'

GENERAL : '1', '2', '3'

'2'

ENTER LOT SIZE:

2000

ENTER AQL IN PERCENT. REMEMBER, ONLY A
STANDARD AQL IS ALLOWABLE

1.5

DO YOU WANT SINGLE('S') OR DOUBLE('D')

SAMPLING PLANS ; (NOTE: ENTER S OR D IN QUOTES).

'S'

THESE PLANS ARE:

:NORMAL:::TIGHTENED:::REDUCED::

AC 1= 5	AC 1= 3	AC 1= 2
RE 1= 6	RE 1= 4	RE 1= 5
N= 125	N= 125	N= 50

DO YOU WANT SCHEME EVALUATION..?

IF YES ENTER.....1

IF NO ENTER.....2

2

Example 4 QMIL.FOR

WHAT DO YOU WISH TO DO?

- 1-DERIVE PLANS TO MINIMIZE ASN
- 2-DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE

3

ENTER INSPECTION LEVEL IN QUOTATION MARKS

E.G. ; SPECIAL : 'S1', 'S2', 'S3', 'S4'

GENERAL : '1', '2', '3'

'2'

ENTER LOT SIZE:

2000

ENTER AQL IN PERCENT. REMEMBER, ONLY A
STANDARD AQL IS ALLOWABLE

1.5

DO YOU WANT SINGLE('S') OR DOUBLE('D')

SAMPLING PLANS ; (NOTE: ENTER S OR D IN QUOTES).

'D'

THESE PLANS ARE:

*:NORMAL:::TIGHTENED:::REDUCED:::

AC 1= 2	AC 1= 1	AC 1= 0
RE 1= 5	RE 1= 4	RE 1= 4
N1= 80	N1= 80	N1= 32
AC 2= 6	AC 2= 4	AC 2= 3
RE 2= 7	RE 2= 5	RE 2= 6
N2= 80	N2= 80	N2= 32

DO YOU WANT SCHEME EVALUATION..?

IF YES ENTER.....1

IF NO ENTER.....2

1

DO YOU WANT A TABLE OR A GRAPH FORMAT ?

FOR GRAPH....ENTER: 1

FOR TABLE....ENTER: 2

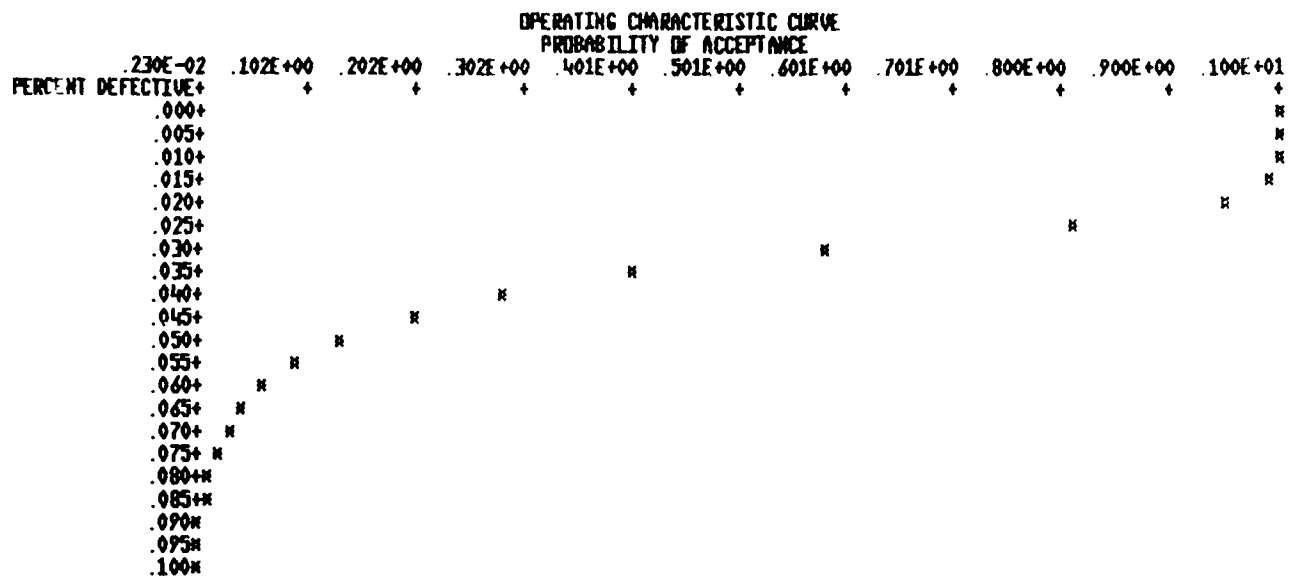
DEPT. OF ISE
UNIVERSITY OF FLORIDA

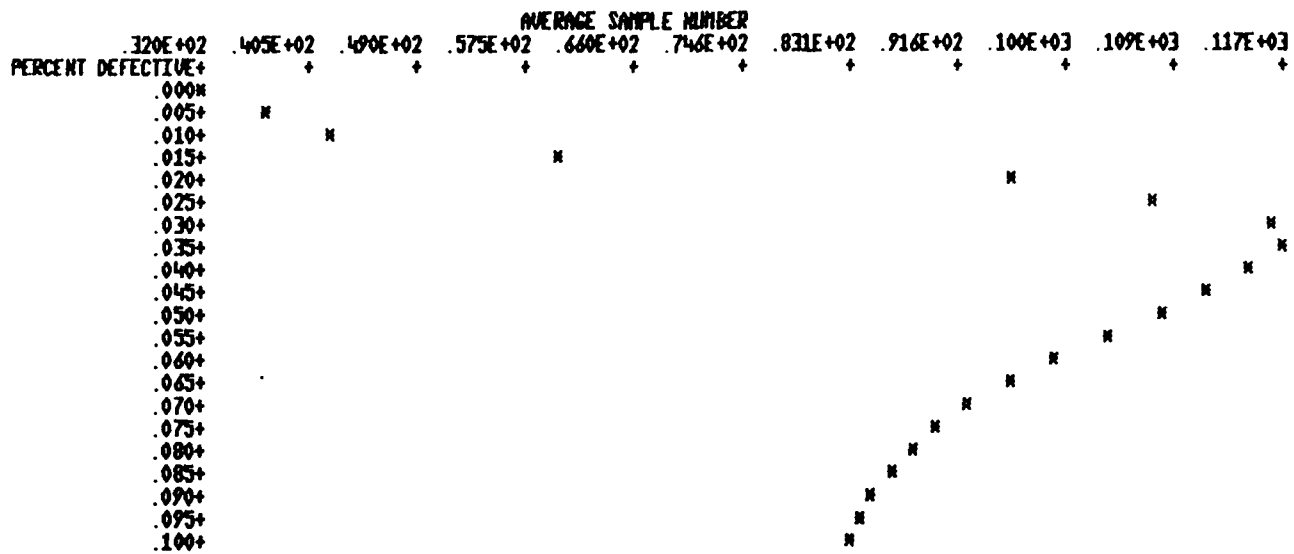
*****SAMPLING SYSTEM TO EVALUATE MIL-STD-105D*****

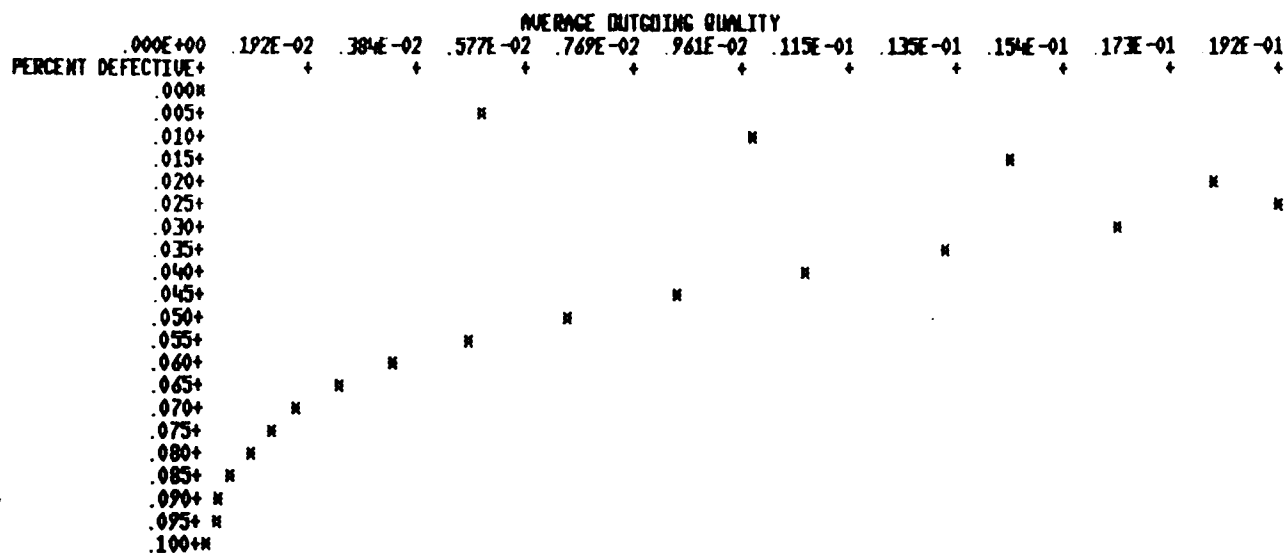
FOR: INSPECTION LEVEL 2
LOT SIZE= 2000
AQL= 1.50000
SAMPLING PLAN D

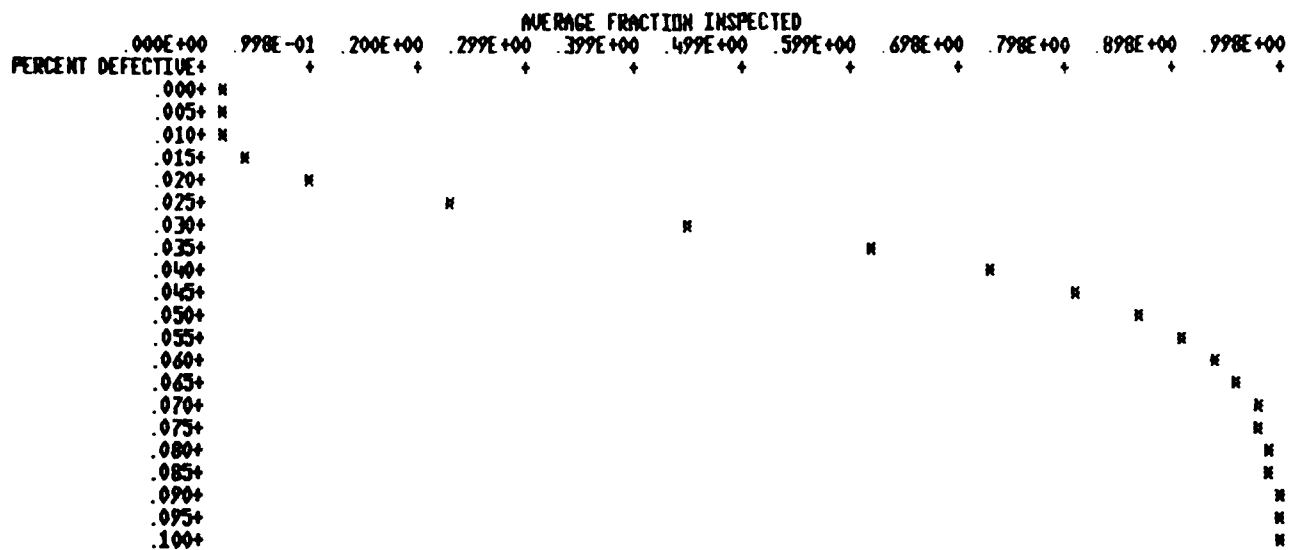
THESE PLANS ARE:

* NORMAL : : : : :			TIGHTENED : : : : :			REDUCED : *		
AC 1=	2		AC 1=	1		AC 1=	0	
RE 1=	5		RE 1=	4		RE 1=	4	
N1=	80		N1=	80		N1=	32	
AC 2=	6		AC 2=	4		AC 2=	3	
RE 2=	7		RE 2=	5		RE 2=	6	
N2=	80		N2=	80		N2=	32	









Example 5 QAFI.FOR

WHAT DO YOU WISH TO DO?

- 1-DERIVE PLANS TO MINIMIZE ASN
- 2-DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE

3

ENTER INSPECTION LEVEL IN QUOTATION MARKS

E.G. ; SPECIAL : 'S1', 'S2', 'S3', 'S4'

GENERAL : '1', '2', '3'

'2'

ENTER LOT SIZE:

2000

ENTER AQL IN PERCENT. REMEMBER, ONLY A
STANDARD AQL IS ALLOWABLE

1.5

DO YOU WANT SINGLE('S') OR DOUBLE('D')

SAMPLING PLANS ; (NOTE: ENTER S OR D IN QUOTES).

'D'

THESE PLANS ARE:

*:NORMAL::::::::::TIGHTENED::::::::::REDUCED:::

AC 1= 2	AC 1= 1	AC 1= 0
RE 1= 5	RE 1= 4	RE 1= 4
N1= 80	N1= 80	N1= 32
AC 2= 6	AC 2= 4	AC 2= 3
RE 2= 7	RE 2= 5	RE 2= 6
N2= 80	N2= 80	N2= 32

DO YOU WANT SCHEME EVALUATION..?

IF YES ENTER.....1

IF NO ENTER.....2

1

DO YOU WANT A TABLE OR A GRAPH FORMAT ?

FOR GRAPH....ENTER: 1

FOR TABLE....ENTER: 2

2

SPECIFY THE NUMBER OF FRACTION DEFECTIVE VALUES..

12

ENTER THE FRACTION DEFECTIVE VALUE(S),

(PUT A COMMA BETWEEN VALUES.).....

.015, .02, .025, .03, .04, .05, .06, .065, .07, .08, .09, .1

SCHEME OPERATING CHARACTERISTICS

P:.....	P(A):.....	ASN:.....	AOQ:.....	AFI
0.015	0.9943	59.80	0.0145	0.04
0.020	0.9467	95.47	0.0180	0.10
0.025	0.8106	107.15	0.0192	0.23
0.030	0.5785	115.85	0.0164	0.45
0.040	0.2833	114.88	0.0107	0.73
0.050	0.1364	107.39	0.0064	0.87
0.060	0.0621	99.40	0.0035	0.94
0.065	0.0413	95.86	0.0026	0.96
0.070	0.0274	92.75	0.0018	0.97
0.080	0.0120	87.90	0.0009	0.99
0.090	0.0053	84.67	0.0005	0.99
0.100	0.0023	82.65	0.0002	1.00

LIMIT NUMBER FOR REDUCED INSPECTION IS: 7

WHAT DO YOU WISH TO DO?

- 1-DERIVE PLANS TO MINIMIZE ASN
- 2-DERIVE PLANS TO MINIMIZE AFI
- 3-EVALUATE MIL-STD-105D SAMPLING SCHEME
- 4-EXIT THIS PROGRAM

ENTER CHOICE
4
FORTRAN STOP

APPENDIX B
Program Listing

Program QMAIN.FOR

```

0001 *****
0002 CONTROLING PROGRAM FOR THE QUALITY CONTROL
0003 INSPECTION SAMPLING SOFTWARE PACKAGE
0004
0005 DR. RICHARD S. LEAVENWORTH
0006 DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING
0007 UNIVERSITY OF FLORIDA
0008 GAINESVILLE, FLORIDA 32611
0009 C*****
0010 C
0011
0012 BYTE OUTFIL(8)
0013 COMMON/BLK1/N25,N2I
0014 COMMON/BLK2/PS,PL
0015 COMMON/BLK3/N1
0016 COMMON/BLK4/ALPHA,BETA
0017 COMMON/BLK5/PO,P1
0018 COMMON/BLK6/C1,C2
0019 COMMON/BLK7/SUMLOG(4000)
0020 COMMON/BLK8/N
0021 COMMON/BLK9/C2MAX,C1MAX(15)
0022 COMMON/BLK10/NS,NL
0023 COMMON/BLK11/ASN,ASNMAX
0024 COMMON/BLK12/OUTFIL
0025 C
0026 NUM=0
0027 10 NUM=NUM+1
0028 WRITE(5,15)
0029 15 FORMAT(////////,23(' '), 'WHAT DO YOU WISH TO DO?')
0030 WRITE(5,20)
0031 20 FORMAT(/,15(' '), '1-DERIVE PLANS TO MINIMIZE ASN')
0032 WRITE(5,25)
0033 25 FORMAT(/,15(' '), '2-DERIVE PLANS TO MINIMIZE AFI')
0034 WRITE(5,30)
0035 30 FORMAT(/,15(' '), '3-EVALUATE MIL-STD-105D SAMPLING SCHEME')
0036 WRITE(5,35)
0037 35 FORMAT(/,15(' '), '4-EXIT THIS PROGRAM')
0038 WRITE(5,40)
0039 40 FORMAT(////////, ' ENTER CHOICE')
0040 READ(5,45) ICH
0041 45 FORMAT(11)
0042 C
0043 IF ((ICH.NE. 1).AND.(ICH.NE. 2).AND.(ICH.NE. 3).AND.
0044 $(ICH.NE. 4)) THEN
0045 WRITE(5,50)
0046 50 FORMAT(/,15(' '), ' YOU MUST ENTER 1,2,3, OR 4')
0047 GO TO 10
0048 ENDIF
0049 C
0050 IF((ICH.NE. 4).AND.(NUM.EQ. 1)) THEN
0051 WRITE(5,*) ' WHAT DO YOU WISH TO CALL YOUR OUTPUT FILE?'
0052 READ(5,55) OUTFIL
0053 55 FORMAT(10A1)
0054 CALL ASSIGN(1,OUTFIL)
0055 ENDIF
0056 C
0057 GO TO (60,65,70,75), ICH

QMAIN$MAIN

0058 C
0059 60 CALL GASN
0060 GO TO 10
0061 65 CALL GAFI
0062 GO TO 10
0063 70 CALL QMII
0064 GO TO 10
0065 75 STOP
0066 END

```

Program QASN.FOR

```

0001
0002
0003      QUANTILE CONTROL DOUBLE SAMPLING PROGRAM TO ANALYSE
0004      DOUBLE SAMPLING PLANS, ASN(P0) AND ASNMAX.
0005      BINOMIAL AND POISSON PROBABILITY DISTRIBUTIONS USED.
0006
0007      PROGRAMED BY R. WARREN RANGARAJAN
0008      DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING
0009      UNIVERSITY OF FLORIDA
0010      GAINESVILLE, FLORIDA 32611
0011      C*****
0012      C
0013      SUBROUTINE QASN
0014      DOUBLE PRECISION SUMLOG
0015      INTEGER C, C1, C2, C1MIN, C2MIN, R1, R11
0016      BYTE OUTFIL(8)
0017
0018      COMMON/BLK1/N2S, N2L
0019      COMMON/BLK2/PS, PL
0020      COMMON/BLK3/N1
0021      COMMON/BLK4/ALPHA, BETA
0022      COMMON/BLK5/P0, P1
0023      COMMON/BLK6/C1, C2
0024      COMMON/BLK7/SUMLOG(4000)
0025      COMMON/BLK8/N
0026      COMMON/BLK9/C2MAX, C1MAX(15)
0027      COMMON/BLK10/NS, NL
0028      COMMON/BLK11/ASN, ASNMAX
0029      COMMON/BLK12/OUTFIL
0030      C*****
0031      C      BEGINNING INITIALIZATION
0032      C*****
0033      N=0
0034      C2=1000
0035      ASNMIN=15000.
0036      C=-1
0037      C*****
0038      C      INPUT FORMAT
0039      C*****
0040      10 WRITE (5,15)
0041      15 FORMAT (///' CODES FOR SELECTING APPR. PROB. DIST. '//
0042      115X, 'BINOMIAL', 12X, '=1',
0043      2/15X, 'POISSON', 13X, '=2')
0044      READ (5,*) K
0045      IF (K.GT.2.OR.K.LT.1) GOTO 10
0046      20 WRITE(5,25)
0047      25 FORMAT(10X, 'SELECT'/16X, 'SAMPLE PLANS ONLY =1'
0048      1/16X, 'ASN VALUES ONLY =2'
0049      2/16X, 'OR BOTH =3')
0050      READ(5,*) KOPT
0051      IF (KOPT.GT.3.OR.KOPT.LT.1) GOTO 20
0052      WRITE (5,30)
0053      30 FORMAT(10X, 'INPUT ALPHA ')
0054      READ (5,*) ALPHA
0055      WRITE (5,35)
0056      35 FORMAT(10X, 'INPUT BETA ')
0057      READ (5,*) BETA

```

GAVIN

```

0058
0059      WRITE (5,40)
0060 40 FORMAT(10X, 'INPUT P0 ')
0061      READ (5,*) P0
0062      WRITE(5,45)
0063 45 FORMAT(10X, 'INPUT P1 ')
0064      READ (5,*) P1
0065      WRITE(5,50)
0066 50 FORMAT( 5X, 'INPUT A SEED FOR SINGLE SAMPLING NO. '//
0067      1' IF NO SEED AVAILABLE ENTER ZERO AS THE SEED VALUE')
0068      READ(5,*) NS
0069      WRITE(5,55)
0070 55 FORMAT( 5X, 'INPUT A VALUE FOR (R1-C2) '//
0071      1' IF R1=C2 THEN THE VALUE WOULD BE 0'//
0072      2' IF R1>C2 THEN THE VALUE WOULD BE A POSITIVE NO.'//
0073      3' IF R1<C2 THEN THE VALUE WOULD BE A NEGATIVE NO.')
0074      READ(5,*) R11
0075
0076      WRITE (1,60)
0077 60 FORMAT('1',///10X, 'DEPT. OF ISE '
0078      1/, 10X, 'UNIVERSITY OF FLORIDA '//
0079      2/5X, 5(' '), 'DOUBLE SAMPLING SYSTEM TO MINIMIZE ASN',
0080      35(' '), 2X, /)
0081      WRITE (5,65) ALPHA, BETA, P0, P1
0082      WRITE (1,65) ALPHA, BETA, P0, P1
0083 65 FORMAT(//10X, 'ALPHA =', F6.4, 5X, 'BETA =', F6.4,
0084      1/10X, 'P0 =', F6.4, 8X, 'P1 =', F6.4)
0085      WRITE(5,70) R11
0086      WRITE(1,70) R11
0087 70 FORMAT(/5X, 'REJECTION NO. OF FIRST SAMPLE (R1) = C2+(', I3, ')')
0088      MC1=10.0/(P1/P0)
0089      75 C=C+1
0090 C*****
0091 C      SINGLE SAMPLING PROCEDURE BEGINS
0092 C*****
0093      80 NS=NS+1
0094 C*****
0095 C      COMPUTATION OF LOWER BOUND OF SINGLE SAMPLING PLAN
0096 C*****
0097      IF(K.EQ.1) CALL PROBS1(NS,P1,C,BXLEC,N)
0098      IF(K.EQ.2) CALL PROBS2(NS,P1,C,BXLEC,N)
0099      IF(BXLEC.GT.BETA) GOTO 80
0100      NLT=NS-1
0101      NL=MAX0(1,NLT)
0102 C*****
0103 C      COMPUTATION OF UPPER BOUND OF SINGLE SAMPLING PLAN
0104 C*****
0105      85 NL=NL+1
0106      IF(K.EQ.1) CALL PROBS1(NL,P0,C,BXLEC)
0107      IF(K.EQ.2) CALL PROBS2(NL,P0,C,BXLEC)
0108      IF(BXLEC.GE.(1-ALPHA)) GOTO 85
0109      NL=NL-1
0110 C*****
0111 C      TEST FOR FEASIBILITY
0112 C*****
0113      IF(NS.GT.NL) GOTO 75
0114      WRITE (5,90)

```



```

0115      WRITE(1,70)
0116      70 FORMAT(1X,'SINGLE SAMPLING PLANS')
0117      WRITE(5,95) C,NS,NL
0118      WRITE(1,95) C,NS,NL
0119      95 FORMAT(10X,'ACCEPTANCE NO. (C) =',I2)
0120      1./10X,'LOWER BOUND ON N (NS) =',I4)
0121      2./10X,'UPPER BOUND ON N (NL) =',I4)
0122      C*****
0123      C      COMPUTATION OF DOUBLE SAMPLING PLAN BEGINS FOR EACH VALUE OF C2
0124      C*****
0125      IF(C.LT.C2) MC=C+MC1-1
0126      C2=C
0127      C
0128      R1 C2+R11
0129      C
0130      DO 140 K1 1,C2
0131      C1=K1-1
0132      C*****
0133      C      CALL SUBROUTINE TO COMPUTE THE FIRST SAMPLE NUMBER
0134      C*****
0135      CALL TRY1(NTRY,C1,P1,NS,BETA,K)
0136      N1=NTRY
0137      IF(NTRY.GT.NS) GOTO 145
0138      C
0139      C
0140      WRITE(5,100)
0141      WRITE(1,100)
0142      100      FORMAT(10X,'DOUBLE SAMPLING PLANS',/)
0143      WRITE(5,105) C1,C2
0144      WRITE(1,105) C1,C2
0145      105      FORMAT(10X,'FOR C1=',I2,2X,'C2=',I2,/)
0146      C
0147      NTEMP=N1
0148      IF(KOPT.EQ.1) WRITE(1,110)
0149      IF(KOPT.EQ.1) WRITE(5,110)
0150      IF(KOPT.EQ.2) WRITE(1,112)
0151      IF(KOPT.EQ.2) WRITE(5,112)
0152      IF(KOPT.EQ.3) WRITE(5,115)
0153      IF(KOPT.EQ.3) WRITE(1,115)
0154      110      FORMAT(11X,'(N1)',3X,'(N2S)' ( N2 ( (N2L)',
0155      1      6X,'PS',10X,'PL'//)
0156      112      FORMAT(10X,'N11',3X,'N2S',4X,'ASNMAX',6X,'ASN',/)
0157      115      FORMAT(10X,'(N1)',3X,'(N2S)',3X,'(N2L)',4X,
0158      1      'ASNMAX',6X,'ASN'//)
0159      NTEMP1=NS
0160      C*****
0161      C      COMPUTATION OF SECOND SAMPLE FOR EACH VALUE OF FIRST SAMPLE
0162      C*****
0163      ASN=FLOAT(NS)*10
0164      DO 135 IZ=NTEMP,NTEMP1
0165      I=IZ
0166      IF ((NTEMP1-I) .LE. (C2*1.5)) GOTO 135
0167      C*****
0168      C      CALL SUBROUTINE TO COMPUTE SECOND SAMPLE
0169      C*****
0170      CALL TRY2(NS,NL,K,I,R1)
0171      IF(KOPT.NE.1) GOTO 125

```

GASN

```

0172      WRITE(1,120) I, N2S, N2L, PS, PL
0173      WRITE(5,120) I, N2S, N2L, PS, PL
0174      120      FORMAT(10X, I4, 5X, I4, 1X, N2, 1X, I4, 4X, F8.6, 4X, F8.6)
0175      GOTO 135
0176      C*****
0177      C      TEST FOR FEASIBILITY
0178      C*****
0179      125      IF(N2S.GT.N2L) GOTO 135
0180      IF(N2S.LT.(C2-C1).OR.I.LE.C2) GOTO 135
0181      ASNTEM=ASN
0182      C*****
0183      C      CALL SUBROUTINE TO COMPUTE ASN(P0) AND ASNMAX VALUES
0184      C*****
0185      CALL ASNN(MC, NS, K, I, KOPT, C1MIN, C2MIN, N1MIN, N2MIN, ASNMIN)
0186      IF(KOPT.NE.3) GOTO 135
0187      WRITE(1,130) I, N2S, N2L, ASNMAX, ASN
0188      WRITE(5,130) I, N2S, N2L, ASNMAX, ASN
0189      130      FORMAT(10X, I3, 5X, I3, 5X, I3, 4X, 2(F8.4, 3X))
0190      IF(ASN.GT.ASNTEM) GOTO 140
0191      135      CONTINUE
0192      C
0193      140 CONTINUE
0194      C
0195      145 IF(C.LT.MC) GOTO 75
0196      IF(KOPT.EQ.1) GO TO 155
0197      WRITE(1,150) ASNMIN, N1MIN, N2MIN, C1MIN, C2MIN
0198      WRITE(5,150) ASNMIN, N1MIN, N2MIN, C1MIN, C2MIN
0199      150 FORMAT(////, 10X, 'GLOBAL MINIMUM ASN(P0)=', F8.2, //
0200      110X, 'CORRESPONDING N1      =', I5//
0201      210X, 'CORRESPONDING N2S     =', I5//
0202      310X, 'CORRESPONDING C1      =', I2//
0203      410X, 'CORRESPONDING C2      =', I2)
0204      C
0205      155 RETURN
0206      END

```

```

0001      SUBROUTINE TRY1(NTRY, C1, P, NL, BETA, K)
0002      C*****
0003      C      THIS SUBROUTINE COMPUTES FIRST SAMPLE NUMBER OF DOUBLE
0004      C      SAMPLING PLAN BY AN INTEGER FORM OF BISECTION METHOD
0005      C*****
0006      INTEGER C1
0007      C
0008      NLARGE=NL
0009      NSMALL=0
0010      C
0011      10 NTRY=(NSMALL+NLARGE)/2.0
0012      C*****
0013      C      CALL APPROPRIATE PROBABILITY SUBROUTINE FOR PROB. CALCULATIONS
0014      C*****
0015      15 IF(K.EQ.1) CALL PROBS1(NTRY, P, C1, BXLFC)
0016      IF(K.EQ.2) CALL PROBS2(NTRY, P, C1, BXLFC)
0017      IF(BXLFC.LE.BETA) GOTO 20
0018      NSMALL=NTRY
0019      GOTO 25
0020      20 NLARGE=NTRY
0021      25 IF(NSMALL.NE.(NLARGE-1)) GOTO 10
0022      NTRY=NLARGE
0023      RETURN
0024      END

```

```

0001      SUBROUTINE TRY2(NS, NL, K, J, R1)
0002      C *****
0003      C THIS SUBROUTINE COMPUTES THE SECOND SAMPLE NUMBER OF
0004      C THE DOUBLE SAMPLING NUMBER BY AN INTEGER BISECTION
0005      C METHOD. SEVERAL TESTS ARE DONE TO LOCATE THE PARAMETER
0006      C AT ITS TRUE POSITION.
0007      C *****
0008      C INTEGER C1, C2, R1
0009      C
0010      C COMMON/BLK1/N2S, N2L
0011      C COMMON/BLK2/PS, PL
0012      C COMMON/BLK3/N1
0013      C COMMON/BLK4/ALPHA, BETA
0014      C COMMON/BLK5/PO, P1
0015      C COMMON/BLK6/C1, C2
0016      C
0017      C K1=C1+1
0018      C *****
0019      C SET LIMITS FOR COMPUTING N2S
0020      C *****
0021      C NSMALL=NS-J
0022      C NLARGE=NSMALL
0023      C *****
0024      C INDEXING TO SPECIFY WHAT BOUND (N2S OR N2L)
0025      C IS BEING COMPUTED
0026      C *****
0027      C I=1
0028      C *****
0029      C INITIAL TEST AT EACH LIMIT
0030      C *****
0031      C CALL PROBD1(J, NSMALL, P1, DPROB, K, R1)
0032      C IF(DPROB.LE.BETA) GOTO 40
0033      C *****
0034      C BISECTION METHOD
0035      C *****
0036      C NLARGE=NL
0037      C 10 NTRY=(NSMALL+NLARGE)/2.0
0038      C GOTO (15, 20), I
0039      C
0040      C 15 CALL PROBD1(J, NTRY, P1, DPROB, K, R1)
0041      C IF(DPROB.LE.BETA) GOTO 30
0042      C GOTO 25
0043      C 20 CALL PROBD1(J, NTRY, PO, DPROB, K, R1)
0044      C IF(DPROB.LT. (1-ALPHA)) GOTO 30
0045      C 25 NSMALL=NTRY
0046      C GOTO 35
0047      C 30 NLARGE=NTRY
0048      C 35 IF((NLARGE-NSMALL).GT.1) GOTO 10
0049      C *****
0050      C CHECK THE INDEX TO FIND WHERE THE PROCESS IS
0051      C *****
0052      C GOTO (40, 45), I
0053      C *****
0054      C CHANGE THE INDEX AFTER N2S COMPUTATION
0055      C *****
0056      C 40 I=I+1
0057      C *****

```

```

0058      C      TESTING EACH POSSIBLE CASES TO LOCATE
0059      C      THE LOWER BOUND AT ITS TRUE POSITION
0060      C      *****
0061      N2S=MAXO(O,NLARGE)
0062      CALL PRORD1(J,NLARGE,P1,DPROB,K,R1)
0063      PS=DPROB
0064      MTEMP=NLARGE-1
0065      NSMALL=MAXO(O,MTEMP)
0066      NLARGE=NI
0067      GOTO 10
0068      45 N2L=NSMALL
0069      CALL PRORD1(J,NSMALL,PO,DPROB,K,R1)
0070      PL=DPROB
0071      CALL PRORD1(J,NLARGE,PO,DPROB,K,R1)
0072      IF(DPROB.GE.(1-ALPHA)) N2L=NLARGE
0073      IF(DPROB.GE.(1-ALPHA)) PL=DPROB
0074      C
0075      50 RETURN
0076      END

```

```

0001      SUBROUTINE PROBS2(NN,P,C,BXLEC)
0002      C*****
0003      C      THIS SUBROUTINE COMPUTES CUMULATIVE POISON
0004      C      PROBABILITIES
0005      C*****
0006      INTEGER C
0007      C
0008      PP=P*NN
0009      TERM=1.0
0010      SUM=TERM
0011      C
0012      IF(C.EQ.0) GOTO 15
0013      DO 10 I=1,C
0014          TERM=TERM*PP/I
0015          SUM=SUM+TERM
0016      10 CONTINUE
0017      C
0018      15 BXLEC=SUM/EXP(PP)
0019      C
0020      RETURN
0021      END

```

```

0001      SUBROUTINE ASNN(MC, NS, K, N11, KOPT, C1MIN, C2MIN, N1MIN, N2MIN, ASNMIN)
0002      C*****
0003      C      THIS SUBROUTINE COMPUTES ASN(PO) VALUES AND
0004      C      ASNMAX VALUES.
0005      C*****
0006      DOUBLE PRECISION SUMLOG
0007      INTEGER C1MIN, C2MIN
0008      C
0009      COMMON/BLK1/N2S, N2L
0010      COMMON/BLK3/N1
0011      COMMON/BLK4/ALPHA, BETA
0012      COMMON/BLK5/PO, P1
0013      COMMON/BLK6/I1, I2
0014      COMMON/BLK7/SUMLOG(4000)
0015      COMMON/BLK8/N
0016      COMMON/BLK11/ASN, ASNMAX
0017      COMMON/BLK12/OUTFIL
0018      C*****
0019      C      INITIALIZATION
0020      C      COMPUTE P* (MAXIMUM PROB. FOR ASNMAX)
0021      C*****
0022      J=I1+1
0023      XXX=0.0
0024      IF(I1.GT.0) XXX=SUMLOG(I1)
0025      AKONST=10.**(SUMLOG(I2)+SUMLOG(N11-I2-1)-XXX-SUMLOG(N11-I1-1))
0026      TEMP=1.0/FLOAT(I2-I1)
0027      AKONST=AKONST**TEMP
0028      PSTAR=AKONST/(1.0+AKONST)
0029      IF(K.EQ.1) CALL PROBS1(N11, PSTAR, I2, BXLEC)
0030      IF(K.EQ.2) CALL PROBS2(N11, PSTAR, I2, BXLEC)
0031      TEMP=BXLEC
0032      IF(K.EQ.1) CALL PROBS1(N11, PSTAR, I1, BXLEC)
0033      IF(K.EQ.2) CALL PROBS2(N11, PSTAR, I1, BXLEC)
0034      TEMP1=TEMP-BXLEC
0035      ASNMAX=FLOAT(N11)+N2S*TEMP1
0036      C
0037      IF(K.EQ.1) CALL PROBS1(N11, PO, I2, BXLEC)
0038      IF(K.EQ.2) CALL PROBS2(N11, PO, I2, BXLEC)
0039      TEMP=BXLEC
0040      IF(K.EQ.1) CALL PROBS1(N11, PO, I1, BXLEC)
0041      IF(K.EQ.2) CALL PROBS2(N11, PO, I1, BXLEC)
0042      TEMP2=TEMP-BXLEC
0043      ASN=FLOAT(N11)+N2S*TEMP2
0044      IF(ASNMAX.GT.NS.OR.ASN.GT.ASNMIN) GOTO 10
0045      ASNMIN=ASN
0046      N1MIN=N11
0047      N2MIN=N2S
0048      C1MIN=I1
0049      C2MIN=I2
0050      C
0051      10 IF(KOPT.NE.2) GOTO 20
0052      WRITE(1,15) N11, N2S, ASNMAX, ASN
0053      WRITE(5,15) N11, N2S, ASNMAX, ASN
0054      15 FORMAT(10X, 2(I3, 3X), 2(F8.4, 3X))
0055      C
0056      20 RETURN
0057      END

```

Program QAFI.FOR

```

0001 C
0002 C*****
0003 C    QUALITY CONTROL PROGRAM TO DERIVE DOUBLE SAMPLING
0004 C    PLANS TO MINIMIZE AVERAGE FRACTION INSPECTED.
0005 C
0006 C    PROGRAMMED BY JO ELLEN WALKER
0007 C    DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING
0008 C    UNIVERSITY OF FLORIDA
0009 C    GAINESVILLE, FLORIDA 32611
0010 C*****
0011 C
0012 C    SUBROUTINE GAFFI
0013 C    INTEGER C1,C2,C,CSTAR,C2M1
0014 C    INTEGER R1,R1M1
0015 C    DOUBLE PRECISION SUMLOG
0016 C    BYTE OUTFIL(8)
0017 C    COMMON/BLK4/ALPHA,BETA
0018 C    COMMON/BLK6/C1,C2
0019 C    COMMON/BLK7/SUMLOG(4000)
0020 C    COMMON/BLK8/N
0021 C    COMMON/BLK12/OUTFIL
0022 C*****
0023 C    INPUT PARAMETERS
0024 C*****
0025 C    KINDEX=1
0026 C    WRITE(5,10)
0027 C    10 FORMAT(10X,'ENTER VALUE OF ALPHA')
0028 C    READ(5,*)ALPHA
0029 C    WRITE(5,15)
0030 C    15 FORMAT(10X,'ENTER VALUE OF PO')
0031 C    READ(5,*)PO
0032 C    WRITE(5,20)
0033 C    20 FORMAT(10X,'ENTER AQGL VALUE')
0034 C    READ(5,*)AQGL
0035 C    WRITE(5,25)
0036 C    25 FORMAT(10X,'ENTER LOT SIZE')
0037 C    READ(5,*)NNN
0038 C
0039 C
0040 C
0041 C    WRITE(1,28)
0042 C    28 FORMAT('1',///10X,'DEPT. OF ISE '
0043 C    $/,10X,'UNIVERSITY OF FLORIDA '/
0044 C    $/5X,5(' '), 'DOUBLE SAMPLING SYSTEM TO MINIMIZE AFI',
0045 C    $5(' '),2X,/)
0046 C    WRITE(5,30)ALPHA
0047 C    WRITE(1,30)ALPHA
0048 C    30 FORMAT(10X,'ALPHA=',2X,F8.6)
0049 C    WRITE(5,35)PO
0050 C    WRITE(1,35)PO
0051 C    35 FORMAT(10X,'PO=',2X,F8.6)
0052 C    WRITE(5,40)AQGL
0053 C    WRITE(1,40)AQGL
0054 C    40 FORMAT(10X,'AQGL=',2X,F8.6)
0055 C    WRITE(5,45)NNN
0056 C    WRITE(1,45)NNN
0057 C    45 FORMAT(10X,'N=',2X,I6)

```

GAT 1

```

0058 C*****
0059 C    COMPUTE SINGLE SAMPLING PLAN
0060 C*****
0061 C
0062 C    INITIALIZATION
0063 C
0064 C*****
0065     NS=1
0066     C=0
0067     N=0
0068     AFI=1. DO
0069 C
0070     WRITE(5, 50)
0071     WRITE(1, 50)
0072 50 FORMAT(///10X, '*** SINGLE SAMPLING PLAN ***')
0073 C*****
0074 C    FIND NS,C COMBO THAT SATISFIES L(PO) G.T. 1-ALPHA
0075 C*****
0076 55 CALL PROBS1(NS, PO, C, BXLEC)
0077     IF(BXLEC.LT.(1. DO-ALPHA))C=C+1
0078     IF(BXLEC.LT.(1. DO-ALPHA))NS=C+1
0079 C*****
0080 C    SEARCH TO FIND MIN NS VALUE SUCH THAT AOQL L.T. AOQL*
0081 C*****
0082 60 CALL SEARCH(NNN, C, NS, SAQG)
0083     IF(SAQG.LE. AOQL)GOTO 75
0084     NSTEMP=NNN
0085     CALL SEARCH(NNN, C, NSTEMP, SAQG)
0086     IF(SAQG. GT. AOQL)C=C+1
0087 C
0088 C
0089     IF(SAQG. GT. AOQL)NS=C+1
0090 C
0091 C
0092     BL=NS
0093     BH=NNN
0094 65 NSTEMP=IIDINT((BL+BH)/2. DO)
0095     CALL SEARCH(NNN, C, NSTEMP, SAQG)
0096     IF(SAQG.LE. AOQL)BH=NSTEMP
0097 C
0098     IF(SAQG.LE. AOQL)AOQ=SAQG
0099 C
0100     IF(SAQG. GT. AOQL)BL=NSTEMP
0101     IF((BH-BL).EQ. 1. DO)GOTO 70
0102     GOTO 65
0103 70 NS=NSTEMP
0104     IF(SAQG. GT. AOQL)NS=BH
0105 C*****
0106 C    CHECK THAT NS,C COMBO STILL SATISFIES L(PO) CONSTRAINT
0107 C*****
0108 75 CALL PROBS1(NS, PO, C, BXLEC)
0109     IF(BXLEC.GE.(1. DO-ALPHA))GOTO 80
0110     C=C+1
0111 C
0112     NS=C+1
0113 C
0114     GOTO 60

```

```

0115 C*****
0116 C    COMPUTE AFI
0117 C*****
0118 80 AFIPO=NS*BXLEC+NNN*(1.DO-BXLEC)
0119 AFIPO=AFIPO/NNN
0120 C
0121 NSTAR=NS
0122 C
0123 WRITE(5,85)NS
0124 WRITE(1,85)NS
0125 85 FORMAT(//10X,'NS=',I3)
0126 WRITE(5,90)C
0127 WRITE(1,90)C
0128 90 FORMAT(10X,'C=',I2)
0129 WRITE(5,95)AFIPO
0130 WRITE(1,95)AFIPO
0131 95 FORMAT(10X,'AFI(PO)=',F8.6)
0132 C
0133 100 CSTAR=C
0134 C*****
0135 C    DOUBLE SAMPLING
0136 C*****
0137 C
0138 WRITE(5,105)
0139 WRITE(1,105)
0140 105 FORMAT(///10X,'** DOUBLE SAMPLING PLANS **')
0141 PLAN=1.DO
0142 C2=CSSTAR
0143 110 R1=C2+1
0144 C2M1=C2-1
0145 C1P0=C1+1
0146 R1M1=R1-1
0147 DDATI=NNN
0148 TTCMIN=1.
0149 C
0150 C1=0
0151 JJ=0
0152 C
0153 WRITE(5,115)
0154 WRITE(1,115)
0155 115 FORMAT(///10X,'C1',6X,'C2',7X,'N1',8X,'N2',9X,'AFI',//)
0156 C*****
0157 C    CALCULATE FIRST SAMPLE NUMBER
0158 C
0159 C    FROM RESULTS OF PREVIOUS RUNS, IT WAS FOUND THAT N1 IS NOT LESS
0160 C    THAN NSTAR/8.  THUS, THE INITIAL VALUE OF N1 IS SET ACCORDINGLY.
0161 C*****
0162 C
0163 120 DO 165 LL=INT(NSTAR/8),NSTAR
0164 N1=LL
0165 IF(N1.LT.C2)N1=R1M1
0166 C*****
0167 C    CHECK B(N1,PO,C2) G.T. 1-ALPHA CONSTRAINT
0168 C*****
0169 125 CALL PROBS1(N1,PO,C2,BXLEC)
0170 IF(BXLEC.LT.(1.-ALPHA))GOTO 175
0171 C*****

```



```

0172 C      CALCULATE SECOND SAMPLE
0173 C *****
0174      N2=NSTAR-N1
0175 C *****
0176 C      CHECK THAT DOUBLE PROBABILITY G.T. 1-ALPHA
0177 C *****
0178      130 CALL PROBD1(N1,N2,P0,DPROB,KINDEX,R1)
0179      IF(DPROB.GE.(1.-ALPHA))GOTO 135
0180      IF(C1.EQ.C2M1)GOTO 175
0181      C1=C1+1
0182      GOTO 130
0183 C *****
0184 C      FIND N2 VALUE SATISFYING AQGL L.T. AQGL*
0185 C *****
0186      135 CALL SRCH2(NNN,N1,N2,AQGL)
0187      IF(AQGL.LE.AQGL)GOTO 150
0188 C *****
0189 C      N2 WILL NOT BE LESS THAN N1*9, THE INITIAL LOWER BOUND ON N2.
0190 C *****
0191      N2TEMP=N1*9
0192 C
0193      CALL SRCH2(NNN,N1,N2TEMP,AQGL)
0194      IF(AQGL.GT.AQGL)GOTO 165
0195 C
0196      BL=N2
0197      BH=N1*9
0198      140 N2TEMP=INT((BL+BH)/2)
0199      CALL SRCH2(NNN,N1,N2TEMP,AQGL)
0200      IF(AQGL.LE.AQGL)BH=N2TEMP
0201      IF(AQGL.LE.AQGL)FAQG=AQGL
0202 C
0203      IF(AQGL.GT.AQGL)BL=N2TEMP
0204      IF((BH-BL).EQ.1.)GOTO 145
0205      GOTO 140
0206      145 N2=N2TEMP
0207      IF(AQGL.GT.AQGL)N2=BH
0208 C *****
0209 C      CHECK THAT BINOMIAL PROBABILITIES ARE G.T. 1-ALPHA
0210 C *****
0211      CALL PROBD1(N1,N2,P0,DPROB,KINDEX,R1)
0212      IF(DPROB.LT.(1.-ALPHA))GOTO 165
0213      150 CALL PROBS1(N1,P0,C1,BXLEC)
0214      PA2=DPROB-BXLEC
0215 C *****
0216 C      COMPUTE ATI
0217 C *****
0218      DATI=N1*DPROB+N2*PA2+NNN*(1.-DPROB)
0219 C *****
0220 C      IF THE ATI INCREASES, CONTINUE FOR 5 ADDITIONAL INCREASING
0221 C      ITERATIONS. THEN INCREMENT C1 AND CONTINUE.
0222 C *****
0223      IF(JJ.EQ.4)GOTO 155
0224      IF(DATI.GE.DDATI)JJ=JJ+1
0225      IF(DATI.GE.DDATI)GOTO 165
0226      DDATI=DATI
0227      DDAQG=FAQG
0228 C

```

```

0229      K1=C1
0230      K2=C2
0231      K3=N1
0232      K4=N2
0233      C
0234      GOTO 165
0235      C*****
0236      C      MINIMUM OF CELL (TCMIN) FOUND
0237      C*****
0238      155 TCMIN=DDATI/NNN
0239      DDAI=NNN
0240      C
0241      WRITE(5,160)K1,K2,K3,K4,TCMIN
0242      WRITE(1,160)K1,K2,K3,K4,TCMIN
0243      160 FORMAT(10X,I2,6X,I2,5X,I4,6X,I4,7X,F8.6)
0244      C*****
0245      C      IF MINIMUM OF COLUMN IS FOUND, INCREASE C2
0246      C*****
0247      IF(TCMIN.GE.TTCMIN)GOTO 170
0248      KK1=K1
0249      KK2=K2
0250      KK3=K3
0251      KK4=K4
0252      TTCMIN=TCMIN
0253      TTAQG=DDAQG
0254      C
0255      IF (C1.EQ.C2M1) GOTO 175
0256      C1=C1+1
0257      C
0258      JJ=0
0259      N1=KK3
0260      C
0261      GOTO 125
0262      C
0263      165 CONTINUE
0264      C*****
0265      C      MINIMUM OF COLUMN (TMIN) FOUND
0266      C*****
0267      170 TMIN=TTCMIN
0268      TDAQ=TDAQG
0269      C*****
0270      C      IF MINIMUM SAMPLING PLAN FOUND, STOP
0271      C*****
0272      IF(TMIN.GE.PLAN)GOTO 190
0273      C
0274      PLAN=TMIN
0275      KKK1=KK1
0276      KKK2=KK2
0277      KKK3=KK3
0278      KKK4=KK4
0279      175 C2=C2+1
0280      C*****
0281      C      NEW BOUNDS ON SAMPLING PLAN CALCULATED FOR NEW VALUE OF C2
0282      C*****
0283      180 CALL SEARCH(NNN,C2,NSTAR,AQG)
0284      IF(AQG.LE.AOGL)GOTO 185
0285      IF(NSTAR.GT.NNN)GOTO 175
0286      NSTAR=NSTAR+1
0287      GOTO 180
0288      C
0289      C
0290      185 CALL PROBS1(NSTAR,PO,C2,BXLEC)
0291      GOTO 110
0292      C
0293      C
0294      190 WRITE(5,195)
0295      WRITE(1,195)
0296      195 FORMAT(/10X,'SAMPLING PLAN MINIMUMS')
0297      WRITE(5,200)KKK1,KKK2
0298      WRITE(1,200)KKK1,KKK2
0299      200 FORMAT(/10X,'C1=',I2,2X,'C2=',I2)
0300      WRITE(5,205)KKK3,KKK4
0301      WRITE(1,205)KKK3,KKK4
0302      205 FORMAT(10X,'N1=',I3,2X,'N2=',I3)
0303      WRITE(5,210)PLAN
0304      WRITE(1,210)PLAN
0305      210 FORMAT(10X,'MINIMUM AFI=',F8.6)
0306      215 RETURN
0307      END

```

```

0001      SUBROUTINE SEARCH(NNN,C,NS,AQG)
0002      C*****
0003      C      SEARCH TO FIND VALUE OF PSTAR USING GOLDEN
0004      C      SECTION METHOD. INITIAL LIMITS OF 0 AND 1
0005      C*****
0006      INTEGER C
0007      DOUBLE PRECISION SUMLOG
0008      COMMON/BLK7/SUMLOG(4000)
0009      COMMON/BLK8/N
0010      C
0011      A1=0. DO
0012      A2=1. DO
0013      T=1. D-3
0014      R=5. D-1*(DSQRT(5. DO)-1. DO)
0015      H=A2-A1
0016      PLFT=A1+(R*R)*H
0017      PRT=A1+(R*H)
0018      C
0019      C
0020      CALL PROBS1(NS,PLFT,C,BXLEC)
0021      ATI=(NS*BXLEC)+NNN*(1. DO-BXLEC)
0022      AFI1=ATI/NNN
0023      AQG1=PLFT*(1. DO-AFI1)
0024      CALL PROBS1(NS,PRT,C,BXLEC)
0025      ATI=(NS*BXLEC)+NNN*(1. DO-BXLEC)
0026      AFI2=ATI/NNN
0027      AQG2=PRT*(1. DO-AFI2)
0028      GOTO 110
0029      C
0030      C
0031      100 CALL PROBS1(NS,PLFT,C,BXLEC)
0032      ATI=(NS*BXLEC)+NNN*(1. DO-BXLEC)
0033      AFI1=ATI/NNN
0034      AQG1=PLFT*(1. DO-AFI1)
0035      GO TO 110
0036      C
0037      105 CALL PROBS1(NS,PRT,C,BXLEC)
0038      ATI=(NS*BXLEC)+NNN*(1. DO-BXLEC)
0039      AFI2=ATI/NNN
0040      AQG2=PRT*(1. DO-AFI2)
0041      C
0042      110 IF(AQG1.LT.AQG2) GOTO 115
0043      A2=PRT
0044      H=PRT-A1
0045      IF(ABS(PRT-PLFT).LE.T)GOTO 120
0046      C
0047      PRT=PLFT
0048      PLFT=A1+(R*R)*H
0049      AQG2=AQG1
0050      GO TO 100
0051      115 A1=PLFT
0052      H=A2-PLFT
0053      C
0054      IF(ABS(PRT-PLFT).LE.T)GOTO 120
0055      PLFT=PRT
0056      PRT=A1+R*H
0057      AQG1=AQG2

```

```

0001      SUBROUTINE SRCH2(NNN,N1,N2,AQG)
0002      C
0003      INTEGER C1,C2,R1
0004      COMMON/BLK6/C1,C2
0005      C
0006      KINDEX=1
0007      A1=0.
0008      A2=1.
0009      T=.0001
0010      R=.5*(DSQRT(5.DO)-1.)
0011      H=A2-A1
0012      PLFT=A1+(R*R)*H
0013      PRT=A1+(R*H)
0014      C
0015      C
0016      CALL PROBS1(N1,PLFT,C1,PA1)
0017      CALL PROBD1(N1,N2,PLFT,DPROB,KINDEX,R1)
0018      PA2=DPROB-PA1
0019      ATI=DPROB*N1+PA2*N2+NNN*(1.-DPROB)
0020      AFI1=ATI/NNN
0021      AQG1=PLFT*(1.-AFI1)
0022      CALL PROBS1(N1,PRT,C1,PA1)
0023      CALL PROBD1(N1,N2,PRT,DPROB,KINDEX,R1)
0024      PA2=DPROB-PA1
0025      ATI=DPROB*N1+PA2*N2+NNN*(1.-DPROB)
0026      AFI2=ATI/NNN
0027      AQG2=PRT*(1.-AFI2)
0028      GOTO 110
0029      C
0030      C
0031      100 CALL PROBS1(N1,PLFT,C1,PA1)
0032      CALL PROBD1(N1,N2,PLFT,DPROB,KINDEX,R1)
0033      PA2=DPROB-PA1
0034      ATI=DPROB*N1+PA2*N2+NNN*(1.-DPROB)
0035      AFI1=ATI/NNN
0036      AQG1=PLFT*(1.-AFI1)
0037      GOTO 110
0038      105 CALL PROBS1(N1,PRT,C1,PA1)
0039      CALL PROBD1(N1,N2,PRT,DPROB,KINDEX,R1)
0040      PA2=DPROB-PA1
0041      ATI=DPROB*N1+PA2*N2+NNN*(1.-DPROB)
0042      AFI2=ATI/NNN
0043      AQG2=PRT*(1.-AFI2)
0044      C
0045      C
0046      110 IF(AQG1.LT.AQG2)GOTO 115
0047      C
0048      C
0049      A2=PRT
0050      H=PRT-A1
0051      IF(ABS(PRT-PLFT).LE.T)GOTO 120
0052      PRT=PLFT
0053      PLFT=A1+(R*R)*H
0054      AQG2=AQG1
0055      GOTO 100
0056      115 A1=PLFT
0057      C
0058      C
0059      H=A2-PLFT
0060      IF(ABS(PRT-PLFT).LE.T)GOTO 120
0061      PLFT=PRT
0062      PRT=A1+R*H
0063      AQG1=AQG2
0064      GOTO 105
0065      C
0066      C
0067      120 PS=(PLFT+PRT)/2.
0068      CALL PROBS1(N1,PS,C1,PA1)
0069      CALL PROBD1(N1,N2,PS,DPROB,KINDEX,R1)
0070      PA2=DPROB-PA1
0071      AFI=(DPROB*N1+PA2*N2+NNN*(1.-DPROB))/NNN
0072      AQG=PS*(1.-AFI)
0073      RETURN
0074      END

```

Program QMIL.FOR

```

0001 *****
0002 SUBROUTINE QMIL
0003 *****
0004 THIS IS AN INTERACTIVE PROGRAM TO EVALUATE
0005 THE MIL-STD-105D SAMPLING SCHEME.
0006 *****
0007 PROGRAMMED BY: AZMAT H. SIDDIQI
0008 INDUSTRIAL AND SYSTEMS ENGINEERING DEPT
0009 UNIVERSITY OF FLORIDA, GAINESVILLE,
0010 FLORIDA 32611
0011 *****
0012 C
0013 SUBROUTINE QMIL
0014 BYTE OUTFIL(8)
0015 CHARACTER I*2, CDL, SP
0016 INTEGER FS, FA, SA, AR, SR, AC, AT, AE, SC, ST, Z, A, B
0017 INTEGER NN, NFS, NFA, NAE, NSA, NAR, NAC, NAT, TN, TFS, TFA, TAE, TSA
0018 INTEGER TAR, TAC, TAT, RN, RFA, RAE, RAR, RAC, RAT, FRR, FTR, FNR, SNR
0019 $ , STR, SRR, RFS, S1, S2, S3, S4, S
0020 COMMON/SCL/L, SP, S, I, NQ, T, R, CDL, FS, D, J, K, AQL, M, FA, SA,
0021 $ AR, SR, AC, AT, AE, SC, ST, Z, NTN, NFS, NFA, NAE, NSA, NAR, NAC, NAT,
0022 $ TN, TFS, TFA, TAE, TSA, TAR, TAC, TAT, RN, RFS, RFA, RAE, RAR, RAC, RAT
0023 $ , FRR, FTR, FNR, SNR, STR, SRR, NNNN
0024 COMMON/BLK12/OUTFIL
0025 C
0026 C
0027 C
0028 THIS SECTION ASKS THE USER TO ENTER VALUES FOR
0029 THE NECESSARY PARAMETERS.
0030 C
0031 C
0032 C
0033 PRINT *, 'ENTER INSPECTION LEVEL IN QUOTATION MARKS '
0034 PRINT *, 'E.G.: SPECIAL : 'S1', 'S2', 'S3', 'S4'
0035 PRINT *, 'GENERAL : '1', '2', '3'
0036 READ *, I
0037 PRINT *, 'ENTER LOT SIZE: '
0038 READ *, L
0039 PRINT *, 'ENTER AQL IN PERCENT. REMEMBER, ONLY A'
0040 PRINT *, 'STANDARD AQL IS ALLOWABLE'
0041 READ *, AQL
0042 PRINT *, 'DO YOU WANT SINGLE('S') OR DOUBLE('D') '
0043 PRINT *, 'SAMPLING PLANS ; (NOTE: ENTER S OR D IN QUOTES). '
0044 READ *, SP
0045 WRITE(1,2)
0046 2 FORMAT('1',///10X, 'DEPT. OF ISE ',
0047 1 /, 10X, 'UNIVERSITY OF FLORIDA '///, 5X, 5('*'),
0048 2 'SAMPLING SYSTEM TO EVALUATE MIL-STD-105D',
0049 3 5('*'), 2X, /)
0050 WRITE(1,3) I
0051 3 FORMAT(//, 10X, 'FOR. INSPECTION LEVEL ', A3)
0052 WRITE(1,4) L
0053 4 FORMAT(16X, 'LOT SIZE= ', I8)
0054 WRITE(1,6) AQL
0055 6 FORMAT(16X, 'AQL= ', F10.5)
0056 WRITE(1,8) SP
0057 8 FORMAT(16X, 'SAMPLING PLAN', A3)

```

```

0058      WRITE(1,2)
0059      WRITE(5,2)
0060      FORMAT(77,16X)  THESE PLAINS ARE
0061      CALL CODE
0062      CALL SS
0063      CALL INDEX
0064      CALL VALUES
0065      S=0
0066      IF (RFA.LT.100) THEN
0067          FRR=RFA+1
0068      ENDIF
0069      IF (RAC.LT.100) THEN
0070          RFA=RAC
0071          FRR=RFA+3
0072      ENDIF
0073      IF (RAI.LT.100) THEN
0074          RFA=RAI
0075          FRR=RFA+2
0076      ENDIF
0077      IF (RAE.LT.100) THEN
0078          RFA=RAI
0079          FRR=RFA+5
0080      ENDIF
0081      IF (RAR.LT.100) THEN
0082          RFA=RAR
0083          FRR=RFA+4
0084      ENDIF
0085      IF (TFA.LT.100) THEN
0086          FTR=TFA+1
0087      ENDIF
0088      IF (TAT.LT.100) THEN
0089          TFA=TAT
0090          FTR=TFA+2
0091      ENDIF
0092      IF (TAC.LT.100) THEN
0093          TFA=TAC
0094          FTR=TFA+3
0095      ENDIF
0096      IF (TAR.LT.100) THEN
0097          TFA=TAR
0098          FTR=TFA+4
0099      ENDIF
0100      IF (TAE.LT.100) THEN
0101          TFA=TAE
0102          FTR=TFA+5
0103      ENDIF
0104      IF (NFA.LT.100) THEN
0105          FNR=NFA+1
0106      ENDIF
0107      IF (NAT.LT.100) THEN
0108          NFA=NAT
0109          FNR=NFA+2
0110      ENDIF
0111      IF (NAC.LT.100) THEN
0112          NFA=NAC
0113          FNR=NFA+3
0114      ENDIF

```

```

0115 IF (NAR.L.T.100) THEN
0116   NLA=NAR
0117   ENR=NAR+1
0118 ENDIF
0119 IF (NAL.L.T.100) THEN
0120   NFA=NAL
0121   ENR=NFA+1
0122 ENDIF
0123 IF (NSA.L.T.100) THEN
0124   NTN=NSA
0125   SNR=NTN+1
0126 ENDIF
0127 IF (TSA.L.T.100) THEN
0128   TN=TSA
0129   STR=TN+1
0130 ENDIF
0131 IF (SC.L.T.100) THEN
0132   Z=SC
0133   SRR=Z+3
0134 ENDIF
0135 IF (ST.L.T.100) THEN
0136   Z=ST
0137   SRR=Z+2
0138 ENDIF
0139 IF (SR.L.T.100) THEN
0140   Z=SR
0141   SRR=Z+4
0142 ENDIF
0143 IF (RFS.GE.L.OR.FS.GE.L.OR.NQ.GE.L.OR.RN.GE.L) THEN
0144   C
0145   C
0146   C: THIS SECTION CONTAINS THE FORMAT STATEMENTS
0147   C: NEEDED TO SET UP TABLES FOR THE PLAN STATISTICS
0148   C: AT THE DIFFERENT INSPECTION LEVELS.
0149   C: THE USER IS ASKED IF SCHEME EVALUATION IS
0150   C: DESIRED, IF SO THEN SUBROUTINE OC IS INVOKED.
0151   C
0152   C
0153   WRITE(1,12)
0154   WRITE(5,12)
0155   12 FORMAT(10X,'USE 100 PERCENT INSPECTION',/, 'AS SAMPLE',
0156   $ ' SIZE EQUALS OR EXCEEDS LOT SIZE')
0157   S=1
0158   ENDIF
0159   IF (S.EQ.1) GO TO 60
0160   IF ((SP.EQ.'S').OR.(SP.EQ.'D'.AND.CDL.NE.'A')) THEN
0161     WRITE(1,14)
0162     WRITE(5,14)
0163     14 FORMAT(10X,'* NORMAL          TIGHTENED          ',
0164     $ ' REDUCED          *')
0165     WRITE(1,16)
0166     WRITE(5,16)
0167     16 FORMAT(10X,54('-',))
0168     WRITE(1,10)NFA,TFA,RFA
0169     WRITE(5,10)NFA,TFA,RFA
0170     10 FORMAT(12X,'AC 1=',I7,10X,'AC 1=',I7)
0171     WRITE(1,20)ENR,FTR,FRR

```

```

0172 WRITE(5,20)NR,FRR,FRR
0173 20 FORMAT(12X,'RE 1=',I3,10X,'RE 1=',I7,10X,'RE 1=',I7)
0174 ENDIF
0175 IF(SP.EQ.'D').AND.CDL.NE.'A')THEN
0176 WRITE(1,25)FS,FS,RFS
0177 WRITE(5,25)FS,FS,RFS
0178 25 FORMAT(12X,'N1=',I5,10X,'N1=',I9,10X,'N1=',I9)
0179 WRITE(1,28)
0180 WRITE(5,28)
0181 28 FORMAT(10X,54('-',))
0182 ENDIF
0183 IF(SP.EQ.'D').AND.CDL.NE.'A')THEN
0184 WRITE(1,30)NTN,TN,Z
0185 WRITE(5,30)NTN,TN,Z
0186 30 FORMAT(12X,'AC 2=',I3,10X,'AC 2=',I7,10X,'AC 2=',I7)
0187 WRITE(1,40)SNR,STR,SRR
0188 WRITE(5,40)SNR,STR,SRR
0189 40 FORMAT(12X,'RE 2=',I3,10X,'RE 2=',I7,10X,'RE 2=',I7)
0190 WRITE(1,45)FS,FS,RFS
0191 WRITE(5,45)FS,FS,RFS
0192 45 FORMAT(12X,'N2=',I5,10X,'N2=',I9,10X,'N2=',I9)
0193 ENDIF
0194 WRITE(1,48)
0195 WRITE(5,48)
0196 48 FORMAT(10X,54('-',))
0197 IF(SP.EQ.'S')THEN
0198 WRITE(1,50)NQ,NQ,RN
0199 WRITE(5,50)NQ,NQ,RN
0200 50 FORMAT(12X,'N=',I6,10X,'N=',I10,10X,'N=',I10)
0201 WRITE(1,51)
0202 WRITE(5,51)
0203 51 FORMAT(10X,54('-',))
0204 ENDIF
0205 IF((SP.EQ.'D').AND.CDL.EQ.'A'.AND.J.GE.19).OR.(SP.EQ.'D'.AND.CDL.
0206 $ EQ.'A'.AND.M.LE.16))THEN
0207 WRITE(1,54)
0208 WRITE(5,54)
0209 54 FORMAT(10X,'SAMPLE SIZE NOT AVAILABLE AT ANY INSPECTION',
0210 $ ' LEVEL',/, 'CORRESPONDING SINGLE SAMPLING PLAN WILL',
0211 $ 'BE USED: ')
0212 SP='S'
0213 GO TO 1
0214 ENDIF
0215 PRINT*, 'DO YOU WANT SCHEME EVALUATION..?'
0216 PRINT *, 'IF YES ENTER.....1'
0217 PRINT *, 'IF NO ENTER.....2'
0218 READ *,AZ
0219 IF(AZ.EQ.2) GO TO 60
0220 IF(AZ.EQ.1) GO TO 58
0221 58 NNNN=L
0222 IF(SP.EQ.'S') JT=1
0223 IF(SP.EQ.'D') JT=2
0224 CALL OC(NNNN,FS,RFS,RFA,SRR,FRR,NQ,RN,TFA,TN,FTR,STR,NFA,NTN
0225 $ ,FNR,SNR,Z,JT,AQL)
0226 60 RETURN
0227 END

```



```

0001 SUBROUTINE SS
0002 C
0003 C*****
0004 C** THIS SUBROUTINE FINDS THE SAMPLE SIZE, TOP
0005 C** BOTH THE DOUBLE AND THE SINGLE SAMPLING PLANS
0006 C** AT NORMAL, TIGHTENED AND REDUCED INSPECTION **
0007 C** LEVELS. **
0008 C*****
0009 C
0010 CHARACTER I*2, CDL, SP
0011 INTEGER FS, FA, SA, AR, SR, AC, AT, AE, SC, ST, Z, NN, NFS, NFA, NAE, NSA
0012 INTEGER NAC, NAT, TN, TFS, TFA, TAE, TSA, TAR, TAC, TAT, RN, RFA, RAE
0013 INTEGER RAR, RAC, RAT, NAR, FRR, RFS, FTR, FNR, SNR, STR, SRR
0014 COMMON/SCL/L, SP, S, I, NG, T, R, CDL, FS, D, J, K, AQL, M, FA, SA, AR
0015 $ , SR, AC, AT, AE, SC, ST, Z, NTN, NFS, NFA, NAE, NSA, NAR,
0016 $ NAC, NAT, TN, TFS, TFA, TAE, TSA, TAR, TAC, TAT, RN, RFS, RFA
0017 $ , RAE, RAR, RAC, RAT, FRR, FTR, FNR, SNR, STR, SRR
0018 IF (SP.EQ. 'S') THEN
0019 IF (CDL.EQ. 'A') THEN
0020 NG=2
0021 ENDIF
0022 IF (CDL.EQ. 'B') THEN
0023 NG=3
0024 ENDIF
0025 IF (CDL.EQ. 'C') THEN
0026 NG=5
0027 ENDIF
0028 IF (CDL.EQ. 'D') THEN
0029 NG=8
0030 ENDIF
0031 IF (CDL.EQ. 'E') THEN
0032 NG=13
0033 ENDIF
0034 IF (CDL.EQ. 'F') THEN
0035 NG=20
0036 ENDIF
0037 IF (CDL.EQ. 'G') THEN
0038 NG=32
0039 ENDIF
0040 IF (CDL.EQ. 'H') THEN
0041 NG=50
0042 ENDIF
0043 IF (CDL.EQ. 'J') THEN
0044 NG=80
0045 ENDIF
0046 IF (CDL.EQ. 'K') THEN
0047 NG=125
0048 ENDIF
0049 IF (CDL.EQ. 'L') THEN
0050 NG=200
0051 ENDIF
0052 IF (CDL.EQ. 'M') THEN
0053 NG=315
0054 ENDIF
0055 IF (CDL.EQ. 'N') THEN
0056 NG=500
0057 ENDIF

```

```

0058      IF (CDL.EQ. 'P') THEN
0059          NG=800
0060      ENDIF
0061      IF (CDL.EQ. 'Q') THEN
0062          NG=1250
0063      ENDIF
0064      IF (CDL.EQ. 'R') THEN
0065          NG=2000
0066      ENDIF
0067      IF (CDL.EQ. 'S') THEN
0068          NG=3150
0069      ENDIF
0070      IF (CDL.EQ. 'A'.OR.CDL.EQ. 'B'.OR.CDL.EQ. 'C') THEN
0071          RN=2
0072      ENDIF
0073      IF (CDL.EQ. 'D') THEN
0074          RN=3
0075      ENDIF
0076      IF (CDL.EQ. 'E') THEN
0077          RN=5
0078      ENDIF
0079      IF (CDL.EQ. 'F') THEN
0080          RN=8
0081      ENDIF
0082      IF (CDL.EQ. 'G') THEN
0083          RN=13
0084      ENDIF
0085      IF (CDL.EQ. 'H') THEN
0086          RN=20
0087      ENDIF
0088      IF (CDL.EQ. 'J') THEN
0089          RN=32
0090      ENDIF
0091      IF (CDL.EQ. 'K') THEN
0092          RN=50
0093      ENDIF
0094      IF (CDL.EQ. 'L') THEN
0095          RN=80
0096      ENDIF
0097      IF (CDL.EQ. 'M') THEN
0098          RN=125
0099      ENDIF
0100      IF (CDL.EQ. 'N') THEN
0101          RN=200
0102      ENDIF
0103      IF (CDL.EQ. 'P') THEN
0104          RN=315
0105      ENDIF
0106      IF (CDL.EQ. 'Q') THEN
0107          RN=500
0108      ENDIF
0109      IF (CDL.EQ. 'R') THEN
0110          RN=800
0111      ENDIF
0112  ENDIF
0113      IF (SP.EQ. 'D'.AND.CDL.EQ. 'A') THEN
0114          FS=0

```

```

0115      ENDIF
0116      IF (SP.EQ. 'D').AND.(CDL.NE. 'A') THEN
0117      IF (CDL.EQ. 'B') THEN
0118      FS=2
0119      ENDIF
0120      IF (CDL.EQ. 'C') THEN
0121      FS=3
0122      ENDIF
0123      IF (CDL.EQ. 'D') THEN
0124      FS=5
0125      ENDIF
0126      IF (CDL.EQ. 'E') THEN
0127      FS=8
0128      ENDIF
0129      IF (CDL.EQ. 'F') THEN
0130      FS=13
0131      ENDIF
0132      IF (CDL.EQ. 'G') THEN
0133      FS=20
0134      ENDIF
0135      IF (CDL.EQ. 'H') THEN
0136      FS=32
0137      ENDIF
0138      IF (CDL.EQ. 'J') THEN
0139      FS=50
0140      ENDIF
0141      IF (CDL.EQ. 'K') THEN
0142      FS=80
0143      ENDIF
0144      IF (CDL.EQ. 'L') THEN
0145      FS=125
0146      ENDIF
0147      IF (CDL.EQ. 'M') THEN
0148      FS=200
0149      ENDIF
0150      IF (CDL.EQ. 'N') THEN
0151      FS=315
0152      ENDIF
0153      IF (CDL.EQ. 'P') THEN
0154      FS=500
0155      ENDIF
0156      IF (CDL.EQ. 'Q') THEN
0157      FS=800
0158      ENDIF
0159      IF (CDL.EQ. 'R') THEN
0160      FS=1250
0161      ENDIF
0162      IF (CDL.EQ. 'S') THEN
0163      FS=2000
0164      ENDIF
0165      ENDIF
0166      IF ((SP.EQ. 'D').AND.(CDL.EQ. 'B'.OR.CDL.EQ. 'C')) THEN
0167      RFS=0
0168      ENDIF
0169      IF (SP.EQ. 'D'.AND.CDL.NE. 'B'.AND.CDL.NE. 'C') THEN
0170      IF (CDL.EQ. 'D') THEN
0171      RFS=2

```

0172	ENDIF
0173	IF (CDL.EQ. 'F') THEN
0174	RFS=3
0175	ENDIF
0176	IF (CDL.EQ. 'F') THEN
0177	RFS=5
0178	ENDIF
0179	IF (CDL.EQ. 'G') THEN
0180	RFS=8
0181	ENDIF
0182	IF (CDL.EQ. 'H') THEN
0183	RFS=13
0184	ENDIF
0185	IF (CDL.EQ. 'J') THEN
0186	RFS=20
0187	ENDIF
0188	IF (CDL.EQ. 'K') THEN
0189	RFS=32
0190	ENDIF
0191	IF (CDL.EQ. 'L') THEN
0192	RFS=50
0193	ENDIF
0194	IF (CDL.EQ. 'M') THEN
0195	RFS=80
0196	ENDIF
0197	IF (CDL.EQ. 'N') THEN
0198	RFS=125
0199	ENDIF
0200	IF (CDL.EQ. 'P') THEN
0201	RFS=200
0202	ENDIF
0203	IF (CDL.EQ. 'Q') THEN
0204	RFS=315
0205	ENDIF
0206	IF (CDL.EQ. 'R') THEN
0207	RFS=500
0208	ENDIF
0209	ENDIF
0210	RETURN
0211	END

```

0001 SUBROUTINE INDEX
0002 C
0003 C*****
0004 C** THIS SUBROUTINE LOCATES THE CELL IN THE **
0005 C** TABLES PRESENTED IN MIL-STD-105D CONTAINING **
0006 C** ACCEPTANCE AND REJECTION NUMBERS FOR ANY **
0007 C** PARTICULAR COMBINATION OF AQL AND CODE LETTER. **
0008 C*****
0009 C
0010 CHARACTER I*2, CDL, SP
0011 INTEGER FS, FA, SA, AR, SR, AC, AT, AE, SC, ST, Z
0012 COMMON/SCL/L, SP, S, I, NG, T, R, CDL, FS, D, J, K, AQL, M, FA, SA, AR,
0013 $ SR, AC, AT, AE, SC, ST, Z
0014 IF (CDL.EQ. 'A') THEN
0015 K=1
0016 ELSE IF (CDL.EQ. 'B') THEN
0017 K=2
0018 ELSE IF (CDL.EQ. 'C') THEN
0019 K=3
0020 ELSE IF (CDL.EQ. 'D') THEN
0021 K=4
0022 ELSE IF (CDL.EQ. 'E') THEN
0023 K=5
0024 ELSE IF (CDL.EQ. 'F') THEN
0025 K=6
0026 ELSE IF (CDL.EQ. 'G') THEN
0027 K=7
0028 ELSE IF (CDL.EQ. 'H') THEN
0029 K=8
0030 ELSE IF (CDL.EQ. 'J') THEN
0031 K=9
0032 ELSE IF (CDL.EQ. 'K') THEN
0033 K=10
0034 ELSE IF (CDL.EQ. 'L') THEN
0035 K=11
0036 ELSE IF (CDL.EQ. 'M') THEN
0037 K=12
0038 ELSE IF (CDL.EQ. 'N') THEN
0039 K=13
0040 ELSE IF (CDL.EQ. 'P') THEN
0041 K=14
0042 ELSE IF (CDL.EQ. 'Q') THEN
0043 K=15
0044 ELSE IF (CDL.EQ. 'R') THEN
0045 K=16
0046 ELSE IF (CDL.EQ. 'S') THEN
0047 K=17
0048 ENDIF
0049 IF (AQL.EQ. 0.010) THEN
0050 J=1
0051 ELSE IF (AQL.EQ. 0.015) THEN
0052 J=2
0053 ELSE IF (AQL.EQ. 0.025) THEN
0054 J=3
0055 ELSE IF (AQL.EQ. 0.040) THEN
0056 J=4
0057 ELSE IF (AQL.EQ. 0.065) THEN

```

```

0058      J=5
0059      ELSE IF (AQL.EQ.0.10) THEN
0060      J=6
0061      ELSE IF (AQL.EQ.0.15) THEN
0062      J=7
0063      ELSE IF (AQL.EQ.0.25) THEN
0064      J=8
0065      ELSE IF (AQL.EQ.0.4) THEN
0066      J=9
0067      ELSE IF (AQL.EQ.0.65) THEN
0068      J=10
0069      ELSE IF (AQL.EQ.1) THEN
0070      J=11
0071      ELSE IF (AQL.EQ.1.5) THEN
0072      J=12
0073      ELSE IF (AQL.EQ.2.5) THEN
0074      J=13
0075      ELSE IF (AQL.EQ.4) THEN
0076      J=14
0077      ELSE IF (AQL.EQ.6.5) THEN
0078      J=15
0079      ELSE IF (AQL.EQ.10) THEN
0080      J=16
0081      ELSE IF (AQL.EQ.15) THEN
0082      J=17
0083      ELSE IF (AQL.EQ.25) THEN
0084      J=18
0085      ELSE IF (AQL.EQ.40) THEN
0086      J=19
0087      ELSE IF (AQL.EQ.65) THEN
0088      J=20
0089      ELSE IF (AQL.EQ.100) THEN
0090      J=21
0091      ELSE
0092      J=22
0093      ENDIF
0094      M=J+K
0095      RETURN
0096      END

```

```

0001          SUBROUTINE VALUES
0002      C
0003      C*****
0004      C** THIS SUBROUTINE FINDS ACCEPTANCE AND REJECTION **
0005      C** NUMBERS FOR THE CELL IDENTIFIED BY SUBROUTINE INDEX. **
0006      C*****
0007      C
0008          CHARACTER 1*2, CDL, SP
0009          INTEGER FS, FA, SA, AR, SR, AC, AT, AE, SC, ST, Z, NN, NFS, NFA, NAE, NSA
0010          INTEGER NAR, NAC, NAT, TN, TFS, TFA, TAE, TAR, TAC, TAT, RN, RFA, RAE
0011          INTEGER FRR, FTR, FNR, SNR, STR, SRR, RAR, RAC, RAT, RFS, TSA
0012          COMMON/SCL/L, SP, S, I, NQ, T, R, CDL, FS, D, J, K, AQL, M, FA, SA,
0013          $ AR, SR, AC, AT, AE, SC, ST, Z, NTN, NFS, NFA, NAE, NSA, NAR, NAC, NAT, TN
0014          $ , TFS, TFA, TAE, TSA, TAR, TAC, TAT, RN, RFS, RFA, RAE, RAR, RAC, RAT
0015          $ , FRR, FTR, FNR, SNR, STR, SRR
0016          NFA=100
0017          TFA=100
0018          RFA=100
0019          NAT=100
0020          TAT=100
0021          RAT=100
0022          TAC=100
0023          RAC=100
0024          TAR=100
0025          RAR=100
0026          TAE=100
0027          RAE=100
0028          TSA=100
0029          NAC=100
0030          NAR=100
0031          NAE=100
0032          NSA=100
0033          ST=100
0034          SC=100
0035          SR=100
0036          IF (SP.EQ. 'S') THEN
0037              IF (M. GE. 2. AND. M. LE. 16) NFA=0
0038              IF (M. GE. 26) NFA=21
0039              IF (M. EQ. 25) NFA=14
0040              IF (M. EQ. 24) NFA=10
0041              IF (M. EQ. 23) NFA=7
0042              IF (M. EQ. 22) NFA=5
0043              IF (M. EQ. 21) NFA=3
0044              IF (M. EQ. 20) NFA=2
0045              IF (M. EQ. 19) NFA=1
0046              IF (M. EQ. 17. AND. J. NE. 16) NFA=0
0047              IF (M. EQ. 18. AND. J. NE. 18) NFA=1
0048              IF (K. EQ. 16. AND. J. LE. 2) NFA=0
0049              IF (J. EQ. 16. AND. K. LE. 2) NFA=1
0050              IF (M. GE. 26) TFA=18
0051              IF (M. EQ. 25) TFA=12
0052              IF (M. EQ. 24) TFA=8
0053              IF (M. EQ. 23) TFA=5
0054              IF (M. EQ. 22) TFA=3
0055              IF (M. EQ. 21) TFA=2
0056              IF (M. GE. 18. AND. M. LE. 20. AND. J. NE. 16) TFA=1
0057              IF (K. EQ. 16. AND. J. EQ. 2) TFA=2

```

```

0058      IF (M.LE. 17. AND. J.LE. 15) RFA=0
0059      IF (J.EQ. 16. AND. K.LE. 2) RFA=1
0060      IF (M.GE. 26) RAC=10
0061      IF (M.EQ. 25) RAC=7
0062      IF (M.EQ. 24) RAC=5
0063      IF (M.EQ. 23) RAC=3
0064      IF (M.EQ. 22. AND. J.LE. 19) RAC=2
0065      IF (M.EQ. 21) RAC=1
0066      IF (M.EQ. 20. AND. J.LE. 18) RAT=1
0067      IF (M.EQ. 19. AND. J.LE. 17) RAT=0
0068      IF (M.GE. 2. AND. M.LE. 16) RFA=0
0069      IF (M.EQ. 17. AND. J.LE. 15) RFA=0
0070      IF (J.LE. 2) RFA=0
0071      IF (J.EQ. 16. AND. K.LE. 3) RAT=0
0072      IF (J.EQ. 17. AND. K.EQ. 1) RAT=0
0073      IF (J.EQ. 21. AND. K.LE. 2) RFA=5
0074      IF (J.EQ. 20. AND. K.EQ. 1) RFA=3
0075      IF (J.EQ. 20. AND. K.EQ. 2) RAT=3
0076      IF (J.EQ. 19. AND. K.EQ. 1) RFA=2
0077      IF (J.EQ. 19. AND. K.EQ. 2) RAT=2
0078      IF (J.EQ. 18. AND. K.EQ. 1) RFA=1
0079      IF (J.EQ. 18. AND. K.EQ. 2) RAT=1
0080  ENDIF
0081      IF (SP.EQ. 'D') THEN
0082          IF (M.LE. 16. AND. J.LE. 15) THEN
0083              NAT=0
0084              NSA=1
0085              TAT=0
0086              TSA=1
0087              RAT=0
0088              ST=0
0089          END IF
0090          IF (K.EQ. 16. AND. J.LE. 2) THEN
0091              NAT=0
0092              NSA=1
0093              TAT=0
0094              TSA=1
0095              RAT=0
0096              ST=0
0097          ENDIF
0098          IF (K.EQ. 1. AND. J.EQ. 18) THEN
0099              NSA=3
0100              NAC=0
0101              TAT=0
0102              TSA=1
0103          ENDIF
0104          IF (M.GE. 26) THEN
0105              NAE=11
0106              NSA=26
0107          ENDIF
0108          IF (M.EQ. 25) THEN
0109              NAR=7
0110              NSA=18
0111          ENDIF
0112          IF (M.EQ. 24) THEN
0113              NAR=5
0114              NSA=12

```


VALUES

```
0115      ENDIF
0116      IF (M. EQ. 23) THEN
0117        NAR=3
0118        NSA=8
0119      ENDIF
0120      IF (M. EQ. 22) THEN
0121        NAC=2
0122        NSA=6
0123      ENDIF
0124      IF (M. EQ. 21) THEN
0125        NAC=1
0126        NSA=4
0127      ENDIF
0128      IF (M. EQ. 20) THEN
0129        NAC=0
0130        NSA=3
0131      ENDIF
0132      IF ((M. EQ. 19. AND. J. GT. 2). OR. (M. EQ. 18. AND. J. GT. 2)) THEN
0133        NAT=0
0134        NSA=1
0135      ENDIF
0136      IF (J. EQ. 16. AND. K. LE. 3) THEN
0137        NAT=0
0138        NSA=1
0139      ENDIF
0140      IF (M. GE. 26) THEN
0141        TAE=9
0142        TSA=23
0143      ENDIF
0144      IF (M. EQ. 25) THEN
0145        TAR=6
0146        TSA=15
0147      ENDIF
0148      IF (M. EQ. 24) THEN
0149        TAR=3
0150        TSA=11
0151      ENDIF
0152      IF (M. EQ. 23) THEN
0153        TAC=2
0154        TSA=6
0155      ENDIF
0156      IF (M. EQ. 22) THEN
0157        TAC=1
0158        TSA=4
0159      ENDIF
0160      IF (M. EQ. 21) THEN
0161        TAC=0
0162        TSA=3
0163      ENDIF
0164      IF (M. GE. 18. AND. M. LE. 20. AND. J. GE. 3) THEN
0165        TAT=0
0166        TSA=1
0167      ENDIF
0168      IF (M. EQ. 26) THEN
0169        RAE=5
0170        SR=12
0171      ENDIF
```

TABLE 18

```

0172      IF (M. EQ. 25) THEN
0173      RAR=3
0174      SR=8
0175      ENDIF
0176      IF (M. EQ. 24) THEN
0177      RAR=2
0178      SC=6
0179      ENDIF
0180      IF (M. EQ. 23) THEN
0181      RAR=1
0182      SC=4
0183      ENDIF
0184      IF (M. EQ. 22) THEN
0185      RAR=0
0186      SC=3
0187      ENDIF
0188      IF (M. EQ. 21) THEN
0189      RAR=0
0190      SR=1
0191      ENDIF
0192      IF (M. EQ. 20) THEN
0193      RAC=0
0194      SR=0
0195      ENDIF
0196      IF (M. EQ. 19) THEN
0197      RAT=0
0198      ST=0
0199      ENDIF
0200      IF (M. EQ. 18. AND. J. GE. 3. AND. J. LE. 15) THEN
0201      RAT=0
0202      ST=0
0203      ENDIF
0204      ENDIF
0205      RETURN
0206      END

```

```

0001      SUBROUTINE CODE
0002      C
0003      C*****
0004      C** THIS SUBROUTINE IDENTIFIES THE CODE LETTER ASSOCIATED **
0005      C** WITH EITHER THE SPECIAL OR GENERAL INSPECTION LEVELS **
0006      C** FOR ANY GIVEN LOT OR BATCH SIZE. **
0007      C*****
0008      C
0009      CHARACTER I*2, CDL, SP
0010      INTEGER S1, S2, S3, S4
0011      COMMON/SCL/L, SP, S, I, NQ, T, R, CDL
0012      IF(I.EQ. 'S1') THEN
0013          IF(L.GE. 2. AND.L.LE. 50) CDL='A'
0014          IF(L.GE. 51. AND.L.LE. 500) CDL='B'
0015          IF(L.GE. 501. AND.L.LE. 35000) CDL='C'
0016          IF(L.GE. 35001) CDL='D'
0017      ENDIF
0018      IF(I.EQ. 'S2') THEN
0019          IF(L.GE. 2. AND.L.LE. 25) CDL='A'
0020          IF(L.GE. 26. AND.L.LE. 150) CDL='B'
0021          IF(L.GE. 151. AND.L.LE. 1200) CDL='C'
0022          IF(L.GE. 1201. AND.L.LE. 35000) CDL='D'
0023          IF(L.GE. 35001) CDL='E'
0024      ENDIF
0025      IF(I.EQ. 'S3') THEN
0026          IF(L.GE. 2. AND.L.LE. 15) CDL='A'
0027          IF(L.GE. 16. AND.L.LE. 25) CDL='B'
0028          IF(L.GE. 26. AND.L.LE. 90) CDL='C'
0029          IF(L.GE. 91. AND.L.LE. 150) CDL='D'
0030          IF(L.GE. 151. AND.L.LE. 500) CDL='E'
0031          IF(L.GE. 501. AND.L.LE. 1200) CDL='F'
0032          IF(L.GE. 1201. AND.L.LE. 10000) CDL='G'
0033          IF(L.GE. 10001. AND.L.LE. 35000) CDL='H'
0034          IF(L.GE. 35001. AND.L.LE. 500000) CDL='J'
0035          IF(L.GE. 500001) CDL='K'
0036      ENDIF
0037      IF(I.EQ. 'S4') THEN
0038          IF(L.GE. 2. AND.L.LE. 15) CDL='A'
0039          IF(L.GE. 16. AND.L.LE. 25) CDL='B'
0040          IF(L.GE. 26. AND.L.LE. 90) CDL='C'
0041          IF(L.GE. 91. AND.L.LE. 150) CDL='D'
0042          IF(L.GE. 151. AND.L.LE. 500) CDL='E'
0043          IF(L.GE. 501. AND.L.LE. 1200) CDL='F'
0044          IF(L.GE. 1201. AND.L.LE. 10000) CDL='G'
0045          IF(L.GE. 10001. AND.L.LE. 35000) CDL='H'
0046          IF(L.GE. 35001. AND.L.LE. 500000) CDL='J'
0047          IF(L.GE. 500001) CDL='K'
0048      ENDIF
0049      IF(I.EQ. '1') THEN
0050          IF(L.GE. 2. AND.L.LE. 15) CDL='A'
0051          IF(L.GE. 16. AND.L.LE. 25) CDL='B'
0052          IF(L.GE. 26. AND.L.LE. 90) CDL='C'
0053          IF(L.GE. 91. AND.L.LE. 150) CDL='D'
0054          IF(L.GE. 151. AND.L.LE. 280) CDL='E'
0055          IF(L.GE. 281. AND.L.LE. 500) CDL='F'
0056          IF(L.GE. 501. AND.L.LE. 1200) CDL='G'
0057          IF(L.GE. 1201. AND.L.LE. 3200) CDL='H'
0058          IF(L.GE. 3201. AND.L.LE. 10000) CDL='J'
0059          IF(L.GE. 10001. AND.L.LE. 35000) CDL='K'

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```

0058      IF (L.GE.35001.AND.L.LE.150000)CDL='L'
0059      IF (L.GE.150001.AND.L.LE.500000)CDL='M'
0060      IF (L.GE.500001)CDL='N'
0061      ENDIF
0062      IF (I.EQ.'2') THEN
0063          IF (L.GE.2.AND.L.LE.8)CDL='A'
0064          IF (L.GE.9.AND.L.LE.15)CDL='B'
0065          IF (L.GE.16.AND.L.LE.25)CDL='C'
0066          IF (L.GE.26.AND.L.LE.50)CDL='D'
0067          IF (L.GE.51.AND.L.LE.90)CDL='E'
0068          IF (L.GE.91.AND.L.LE.150)CDL='F'
0069          IF (L.GE.151.AND.L.LE.280)CDL='G'
0070          IF (L.GE.281.AND.L.LE.500)CDL='H'
0071          IF (L.GE.501.AND.L.LE.1200)CDL='J'
0072          IF (L.GE.1201.AND.L.LE.3200)CDL='K'
0073          IF (L.GE.3201.AND.L.LE.10000)CDL='L'
0074          IF (L.GE.10001.AND.L.LE.35000)CDL='M'
0075          IF (L.GE.35001.AND.L.LE.150000)CDL='N'
0076          IF (L.GE.150001.AND.L.LE.500000)CDL='P'
0077          IF (L.GE.500001)CDL='Q'
0078      ENDIF
0079      IF (I.EQ.'3') THEN
0080          IF (L.GE.2.AND.L.LE.8)CDL='B'
0081          IF (L.GE.9.AND.L.LE.15)CDL='C'
0082          IF (L.GE.16.AND.L.LE.25)CDL='D'
0083          IF (L.GE.26.AND.L.LE.50)CDL='E'
0084          IF (L.GE.51.AND.L.LE.90)CDL='F'
0085          IF (L.GE.91.AND.L.LE.150)CDL='G'
0086          IF (L.GE.151.AND.L.LE.280)CDL='H'
0087          IF (L.GE.281.AND.L.LE.500)CDL='J'
0088          IF (L.GE.501.AND.L.LE.1200)CDL='K'
0089          IF (L.GE.1201.AND.L.LE.3200)CDL='L'
0090          IF (L.GE.3201.AND.L.LE.10000)CDL='M'
0091          IF (L.GE.10001.AND.L.LE.35000)CDL='N'
0092          IF (L.GE.35001.AND.L.LE.150000)CDL='P'
0093          IF (L.GE.150001.AND.L.LE.500000)CDL='Q'
0094          IF (L.GE.500001)CDL='R'
0095      ENDIF
0096      RETURN
0097      END

```

```

0001      SUBROUTINE DC(NNNN, IFS, IRFS, IRFA, ISRR, IFRR, NG, IRN, ITFA
0002      4 ITN, IFTR, ISTR, NFA, NTN, IFNR, ISNR, IZ, J, AQL)
0003      C
0004      C*****
0005      C** THIS SUBROUTINE EVALUATES THE SCHEME OPERATING **
0006      C** CHARACTERISTICS, FOR THE REQUIRED SAMPLING PLANS. **
0007      C*****
0008      C
0009      REAL*8 AQ(20,20), BQ(20,20)
0010      DIMENSION N(30), PR(30), V(100,50), P(30), TPA(30,4), ASN(30,4)
0011      DIMENSION AQC(30,4), ATI(30,4), NN(4), TM(20,20), ZP(20,20)
0012      DIMENSION ASNC(30), AQC(30), ATIC(30), AFI(30), PA(30)
0013      INTEGER A(50), R(50), HI, AA(2,4), RR(2,4)
0014      IF(J.EQ.2) GO TO 197
0015      IF(J.EQ.1) GO TO 172
0016      172 NN(1)=NG
0017      NN(2)=NG
0018      NN(3)=IRN
0019      NN(4)=IRN
0020      AA(1,4)=IFRR-1
0021      RR(1,3)=IRFA+1
0022      GO TO 272
0023      197 NN(1)=IFS
0024      NN(2)=IFS
0025      NN(3)=IRFS
0026      NN(4)=IRFS
0027      AA(1,4)=IRFA
0028      AA(2,4)=ISRR-1
0029      RR(1,3)=IFRR
0030      272 AA(1,1)=ITFA
0031      AA(2,1)=ITN
0032      RR(1,1)=IFTR
0033      RR(2,1)=ISTR
0034      AA(1,2)=NFA
0035      AA(2,2)=NTN
0036      RR(1,2)=IFNR
0037      RR(2,2)=ISNR
0038      AA(1,3)=IRFA
0039      AA(2,3)=IZ
0040      RR(2,3)=IZ+1
0041      RR(1,4)=IFRR
0042      RR(2,4)=ISRR
0043      PRINT *, 'DO YOU WANT A TABLE OR A GRAPH FORMAT ?'
0044      PRINT *, 'FOR GRAPH....ENTER: 1'
0045      PRINT *, 'FOR TABLE....ENTER: 2'
0046      READ *, XTC
0047      IF(XTC.EQ.1) GO TO 733
0048      PRINT *, 'SPECIFY THE NUMBER OF FRACTION DEFECTIVE VALUES..'
0049      READ *, J1
0050      PRINT *, 'ENTER THE FRACTION DEFECTIVE VALUE(S), '
0051      PRINT *, '(PUT A COMMA BETWEEN VALUES.).....'
0052      READ *, (P(I), I=1, J1)
0053      WRITE(1,27)
0054      WRITE(5,27)
0055      GO TO 447
0056      733 J1=21
0057      DO 55 I=1, J1

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0058      P(I) = (I-1)/20.0
0059      P(I) = P(I)/10.0
0060      44      DO 105 J=1,J1
0061      DO 10 I=1,4
0062      DO 17 J=1,J
0063      A(I) = AA(I,I,M)
0064      R(I) = RR(I,I,M)
0065      N(I) = NN(I,M)
0066      17      CONTINUE
0067      NNN = NNNN
0068      M = INT(NNN * P(I))
0069      ZNK = NNN * P(I)
0070      ZN = M
0071      IF (ZNK - ZN .LE. 0.5) GO TO 148
0072      M = M + 1
0073      148      CONTINUE
0074      SUM = 0
0075      I1 = R(I)
0076      C
0077      C
0078      C THE NEXT STATEMENTS CALCULATE THE PROBABILITY THAT
0079      C THERE ARE (I-1) DEFECTIVES IN THE FIRST SAMPLE.
0080      C
0081      C
0082      DO 20 J=1,I1
0083      V(I,1) = PP(N(I),P(I),I-1)
0084      20      SUM = SUM + V(I,1)
0085      V(R(I)+1,1) = 1. - SUM
0086      IF (A(I) .LE. 0) GO TO 21
0087      I1 = A(I)
0088      C
0089      C
0090      C THE FOLLOWING STATEMENTS CALCULATE THE PROB. THAT THERE
0091      C ARE LESS THAN OR EQUAL TO A(I) DEFECTIVE ITEMS.
0092      C
0093      C
0094      DO 30 I=1,I1
0095      C
0096      C
0097      C THE NEXT SECTION CALCULATES THE INTERMEDIATE PROBABILITIES
0098      C OF CONTINUED SAMPLING FOR THE DOUBLE SAMPLING PLANS.
0099      C
0100      C
0101      C
0102      30      V(A(I)+1,1) = V(A(I)+1,1) + V(I,1)
0103      21      IF (J .EQ. 1) GO TO 41
0104      LOW = 1
0105      I = 2
0106      NNN = NNN - N(I-1)
0107      NR = R(I)
0108      LOW = MAX0(LOW, A(I-1)+2)
0109      HI = R(I-1)
0110      DO 60 I1=1,NR
0111      V(I1,I) = 0
0112      IF (I1 .LT. LOW) GO TO 60
0113      IF (A(I) .EQ. (-1)) GO TO 61
0114      IF (A(I)+1 .NE. I1) GO TO 61

```

```

0115      NMM=MINO(I1,I1)
0116      DO 70 I2=LOW ,MMM
0117      I4=I1-I2+1
0118      DO 50 I1=1,NR
0119      PR(I1)=PP(N(I),P(L),I1-1,NNN,M,I2+1)
0120      50 CONTINUE
0121      DO 80 I3=1,I4
0122      80 V(I1,I)=V(I1,I)+V(I2,I-1)*PR(I3)
0123      70 CONTINUE
0124      GO TO 60
0125      61 MMM=MINO(HI,I1)
0126      DO 90 I2=LOW ,MMM
0127      I3=I1-I2+1
0128      DO 743 IJ=1,NR
0129      743 PR(IJ)=PP(N(I),P(L),IJ-1)
0130      90 V(I1,I)=V(I1,I)+V(I2,I-1)*PR(I3)
0131      60 CONTINUE
0132      V(R(I)+1,I)=0
0133      DO 110 I1=LOW ,HI
0134      SUM=0
0135      I3=R(I)-I1+1
0136      DO 120 I2=1,I3
0137      120 SUM=SUM+PR(I2)
0138      110 V(R(I)+1,I)=V(R(I)+1,I)+(1.-SUM)*V(I1,I-1)
0139      41 CONTINUE
0140      C
0141      C
0142      C THE NEXT SECTION EVALUATES THE SCHEME FOR THE SINGLE
0143      C SAMPLING PLAN (OR THE FIRST STAGE IN DOUBLE SAMPLING).
0144      C
0145      C
0146      121 ASN(L,LM)=0
0147      TPA(L,LM)=0
0148      SS=0
0149      DO 130 I=1,J
0150      SS=SS+N(I)
0151      IF(A(I).EQ.(-1)) GO TO 131
0152      ASN(L,LM)=ASN(L,LM)+(V(A(I)+1,I)+V(R(I)+1,I))*SS
0153      TPA(L,LM)=TPA(L,LM)+V(A(I)+1,I)
0154      GO TO 130
0155      131 ASN(L,LM)=ASN(L,LM)+V(R(I)+1,I)*SS
0156      130 CONTINUE
0157      XXX=0
0158      SSS=0
0159      VVV=0
0160      DO 133 I=1,J
0161      SSS=SSS+N(I)
0162      XXX=XXX+SSS*V(A(I)+1,I)
0163      VVV=VVV+(NNNN-SSS)*V(A(I)+1,I)
0164      133 CONTINUE
0165      ATI(L,LM)=XXX+(NNNN*(1.0-TPA(L,LM)))
0166      AQQ(L,LM)=(VVV*P(L))/NNNN
0167      140 CONTINUE
0168      10 CONTINUE
0169      19 FORMAT(10X,F5.3,2X,F9.4,F10.2,4X,F6.4,1X,F10.2)
0170      27 FORMAT(///,16X,'SCHEME OPERATING CHARACTERISTICS ',/,10X
0171      $ , 'P: ',P(A), 'ASN: ',ASN, 'AQQ: ',AQQ, 'AFI: ')

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0172      DO 1 I=1,20
0173      DO 1 J=1,20
0174      1      TM(I,J)=0
0175
0176      C
0177      C      THIS SECTION FIRST CALCULATES THE PROB. OF BEING
0178      C      IN NORMAL, TIGHTENED OR REDUCED INSPECTION LEVELS AND
0179      C      THEN COMPUTES THE PROB. OF PASSING THE LIMIT NUMBER
0180      C      CRITERIA.
0181      C
0182      C
0183      T=TPA(L,1)
0184      S=TPA(L,2)
0185      RR1=TPA(L,3)
0186      R1=TPA(L,4)
0187      NZ=10*ASN(L,2)
0188      CALL LNM(AQL,NZ,LNC)
0189      Q=B(NZ,P(L),LNC)
0190
0191      C
0192      C      THIS SECTION READS IN THE PROBABILITY TRANSITION MATRIX.
0193      C
0194      C
0195      TM(1,1)=1.-T
0196      TM(1,2)=T
0197      TM(2,1)=1.-T
0198      TM(2,3)=T
0199      TM(3,1)=1.-T
0200      TM(3,4)=T
0201      TM(4,1)=1.-T
0202      TM(4,5)=T
0203      TM(5,1)=1.-T
0204      TM(5,6)=T
0205      TM(6,7)=1.-S
0206      TM(6,11)=S
0207      TM(7,1)=1.-S
0208      TM(7,8)=S
0209      TM(8,1)=1.-S
0210      TM(8,9)=S
0211      TM(9,1)=1.-S
0212      TM(9,10)=S
0213      TM(10,1)=1.-S
0214      TM(10,14)=S
0215      TM(11,7)=1.-S
0216      TM(11,12)=S
0217      TM(12,7)=1.-S
0218      TM(12,13)=S
0219      TM(13,7)=1.-S
0220      TM(13,14)=S
0221      TM(14,7)=1.-S
0222      TM(14,15)=S
0223      TM(15,7)=1.-S
0224      TM(15,16)=S
0225      TM(16,7)=1.-S
0226      TM(16,17)=S
0227      TM(17,7)=1.-S
0228      TM(17,18)=S

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```

0230      TM(18, 7)=1.0
0231      TM(18, 19)=S
0232      TM(19, 7)=1.0
0233      TM(19, 19)=(1.-Q)*S
0234      TM(19, 20)=Q*S
0235      TM(20, 6)=1.-RR1
0236      TM(20, 20)=RR1
0237      NR=20
0238      NC=20
0239      DO 100 I=1, NR
0240      DO 100 JJ=1, NC
0241      IF (JJ-1) 111, 15, 111
0242      ZP(JJ, I)=TM(I, JJ)-1.0
0243      GO TO 100
0244      ZP(JJ, I)=TM(I, JJ)
0245      111 CONTINUE
0246      DO 115 I=2, NR
0247      DO 115 JJ=1, NC
0248      KL=I-1
0249      AQ(I, JJ)=ZP(KL, JJ)
0250      115 CONTINUE
0251      DO 18 JJ=1, NC
0252      AQ(1, JJ)=1.0
0253      18 CONTINUE
0254      CALL INVERT(NR, AQ, BQ)
0255      PA(L)=0
0256      ASNC(L)=0
0257      ADQC(L)=0
0258      ATIC(L)=0
0259      DO 161 I=1, NR
0260      IF (I.GT.5) GO TO 200
0261      ZZ=T
0262      Z1=ASN(L, 1)
0263      Z2=AQG(L, 1)
0264      Z3=ATI(L, 1)
0265      GO TO 201
0266      200 IF (I.GT.19) GO TO 210
0267      ZZ=S
0268      Z1=ASN(L, 2)
0269      Z2=AQG(L, 2)
0270      Z3=ATI(L, 2)
0271      GO TO 201
0272      210 ZZ=R1
0273      Z1=ASN(L, 4)
0274      Z2=AQG(L, 4)
0275      Z3=ATI(L, 4)
0276
0277      C
0278      C THE FOLLOWING STATEMENTS MULTIPLY THE PROBABILITIES
0279      C OF BEING IN THE VARIOUS STATES BY THE CHARACTERISTICS
0280      C OF EACH STATE.
0281      C
0282      201 PA(L)=PA(L)+BQ(I, 1)*ZZ
0283      ASNC(L)=ASNC(L)+BQ(I, 1)*Z1
0284      ADQC(L)=ADQC(L)+BQ(I, 1)*Z2
0285      ATIC(L)=ATIC(L)+BQ(I, 1)*Z3

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0286      AFI(L)=ATIC(L)/NNNN
0287      151  CONTINUE
0288      IF(XTC.NE.2) GO TO 101
0289      WRITE(1,19) P(L),PA(L),ASNC(L),ADQC(L),AFI(L)
0290      WRITE(5,19) P(L),PA(L),ASNC(L),ADQC(L),AFI(L)
0291      101  CONTINUE
0292      IF(XTC.EQ.2) GO TO 556
0293      WRITE(1,45)
0294      WRITE(5,45)
0295      WRITE(1,46)
0296      WRITE(5,46)
0297      CALL PLOTDC(P,PA)
0298      WRITE(1,47)
0299      WRITE(5,47)
0300      CALL PLOTDC(P,ASNC)
0301      WRITE(1,48)
0302      WRITE(5,48)
0303      CALL PLOTDC(P,ADQC)
0304      WRITE(1,49)
0305      WRITE(5,49)
0306      CALL PLOTDC(P,AFI)
0307      45  FORMAT(1H1,50X,'OPERATING CHARACTERISTIC CURVE')
0308      46  FORMAT(53X,'PROBABILITY OF ACCEPTANCE')
0309      47  FORMAT(1H1,50X,'AVERAGE SAMPLE NUMBER')
0310      48  FORMAT(1H1,50X,'AVERAGE OUTGOING QUALITY')
0311      49  FORMAT(1H1,50X,'AVERAGE FRACTION INSPECTED')
0312      GO TO 898
0313      556  CONTINUE
0314      WRITE(1,555),LNC
0315      WRITE(5,555),LNC
0316      555  FORMAT(10X,'LIMIT NUMBER FOR REDUCED INSPECTION IS:',I9)
0317      898  RETURN
0318      END

```

```

0001      FUNCTION PP(N,P,K)
0002      Q=1. P
0003      PP=Q**N
0004      IF (K.EQ.0) RETURN
0005      DO 20 I=1,K
0006      20 PP=PP*P*(N-I+1)/(Q*I)
0007      RETURN
0008      END

```

```

0001      FUNCTION BGN P, K
0002      PN=P*N
0003      Q=1.-P
0004      IF (PN.GT.0.) GO TO 1
0005      B=EXP(-PN)
0006      Z=EXP(-PN)
0007      IF (K.EQ.0) RETURN
0008      DO 10 I=1, K
0009          Z=Z*PN/I
0010      10  B=B+Z
0011      RETURN
0012      1  B=Q**N
0013          Z=Q**N
0014      IF (K.EQ.0) RETURN
0015      DO 20 I=1, K
0016          Z=Z*(N-I+1)*P/(Q*I)
0017      20  B=B+Z
0018      RETURN
0019      END

```

```

0001          SUBROUTINE INVERT(NR, AQ, BQ)
0002      (
0003      (*****
0004      ( ** THIS SUBROUTINE INVERTS THE MATRIX BY GAUSSIAN **
0005      ( ** ELIMINATION. **
0006      (*****
0007      (
0008          REAL*8 AQ(20, 20), BQ(20, 20), ZTAMP, ATEMP
0009          DO 15 I=1, NR
0010              DO 10 J=1, NR
0011                  BQ(I, J)=0.0
0012              15 BQ(I, I)=1.0
0013              DO 35 I=1, NR
0014                  ZTAMP=AQ(I, I)
0015                  DO 20 J=1, NR
0016                      AQ(I, J)=AQ(I, J)/ZTAMP
0017                      BQ(I, J)=BQ(I, J)/ZTAMP
0018              DO 30 II=1, NR
0019                  IF(I.EQ.II) GO TO 30
0020                  ATEMP=AQ(II, I)
0021                  DO 25 J=1, NR
0022                      AQ(II, J)=AQ(II, J)-AQ(I, J)*ATEMP
0023                      BQ(II, J)=BQ(II, J)-BQ(I, J)*ATEMP
0024              30 CONTINUE
0025              35 CONTINUE
0026          RETURN
0027      END

```

```

0001          SUBROUTINE PLOTDC(P,T)
0002
0003      C *****
0004      C * THIS SUBROUTINE PLOTS DC, ASN, ADD AND AFI CURVES FOR *
0005      C * THE FULL RANGE OF INCOMING FRACTION DEFECTIVE. *
0006      C *****
0007      C
0008          DIMENSION U(11),T(30),P(30),LINE(101)
0009          INTEGER ASTERK,BLANK,PLUS
0010          DATA ASTERK,BLANK,PLUS/'*', ' ', '+'/
0011          DO 1 K=1,101
0012      1      LINE(K)=BLANK
0013              XMAX=T(1)
0014              XMIN=T(1)
0015              DO 2 I=1,21
0016                  IF(T(I).LT.XMIN) XMIN=T(I)
0017                  IF(T(I).GT.XMAX) XMAX=T(I)
0018      2      CONTINUE
0019              IF(XMAX.LT.1) XMIN=0
0020              RANGE=XMAX-XMIN
0021              RG=RANGE/10
0022              U(1)=XMIN
0023              DO 3 I=2,11
0024      3      U(I)=U(I-1)+RG
0025                  WRITE(1,130)(U(I),I=1,11)
0026                  WRITE(5,130)(U(I),I=1,11)
0027              DO 4 K=1,101,10
0028      4      LINE(K)=PLUS
0029                  WRITE(1,100)(LINE(K),K=1,101)
0030                  WRITE(5,100)(LINE(K),K=1,101)
0031              DO 6 K=1,21
0032                  DO 5 I=1,101
0033      5      LINE(I)=BLANK
0034                  KPRINT=100*(T(K)-XMIN)/RANGE+1.5
0035                  LINE(1)=PLUS
0036                  LINE(KPRINT)=ASTERK
0037                      WRITE(1,140)P(K), (LINE(I),I=1,101)
0038                      WRITE(5,140)P(K), (LINE(I),I=1,101)
0039      6      CONTINUE
0040      100      FORMAT(4X, 'PERCENT DEFECTIVE',101A1)
0041      130      FORMAT(12X,11(2X,E8.3))
0042      140      FORMAT(17X,F4.3,101A1)
0043          RETURN
0044          END

```

```

0001      SUBROUTINE LNC(AQL,NZ,LNC)
0002      C
0003      C*****
0004      C**      THIS SUBROUTINE FINDS THE LIMIT NUMBER      **
0005      C**      FOR REDUCED INSPECTION.                      **
0006      C*****
0007      C
0008      LNC=222
0009      IF(NZ.LE.29.AND.AQL.LE.15) LNC=0
0010      IF(NZ.GE.30.AND.NZ.LE.49.AND.AQL.LE.10) LNC=0
0011      IF(NZ.GE.50.AND.NZ.LE.79.AND.AQL.LE.6.5) LNC=0
0012      IF(NZ.GE.80.AND.NZ.LE.129.AND.AQL.LE.4.0) LNC=0
0013      IF(NZ.GE.130.AND.NZ.LE.199.AND.AQL.LE.2.5) LNC=0
0014      IF(NZ.GE.200.AND.NZ.LE.319.AND.AQL.LE.1.5) LNC=0
0015      IF(NZ.GE.320.AND.NZ.LE.499.AND.AQL.LE.1.0) LNC=0
0016      IF(NZ.GE.500.AND.NZ.LE.799.AND.AQL.LE.0.65) LNC=0
0017      IF(NZ.GE.800.AND.NZ.LE.1249.AND.AQL.LE.0.40) LNC=0
0018      IF(NZ.GE.1250.AND.NZ.LE.1999.AND.AQL.LE.0.25) LNC=0
0019      IF(NZ.GE.2000.AND.NZ.LE.3149.AND.AQL.LE.0.15) LNC=0
0020      IF(NZ.GE.3150.AND.NZ.LE.4999.AND.AQL.LE.0.10) LNC=0
0021      IF(NZ.GE.5000.AND.NZ.LE.7999.AND.AQL.LE.0.065) LNC=0
0022      IF(NZ.GE.8000.AND.NZ.LE.12499.AND.AQL.LE.0.040) LNC=0
0023      IF(NZ.GE.12500.AND.NZ.LE.19799.AND.AQL.LE.0.025) LNC=0
0024      IF(NZ.GE.20000.AND.NZ.LE.31499.AND.AQL.LE.0.015) LNC=0
0025      IF(NZ.GE.31500.AND.NZ.LE.49779.AND.AQL.LE.0.010) LNC=0
0026      IF(LNC.EQ.0) GO TO 10
0027      IF(NZ.LE.29) THEN
0028          IF(AQL.EQ.25) LNC=2
0029          IF(AQL.EQ.40) LNC=4
0030          IF(AQL.EQ.65) LNC=8
0031          IF(AQL.EQ.100) LNC=14
0032      ENDIF
0033      IF(NZ.GE.30.AND.NZ.LE.49) THEN
0034          IF(AQL.EQ.15) LNC=1
0035          IF(AQL.EQ.25) LNC=3
0036          IF(AQL.EQ.40) LNC=7
0037          IF(AQL.EQ.65) LNC=13
0038          IF(AQL.EQ.100) LNC=22
0039      ENDIF
0040      IF(NZ.GE.50.AND.NZ.LE.79) THEN
0041          IF(AQL.EQ.10) LNC=2
0042          IF(AQL.EQ.15) LNC=3
0043          IF(AQL.EQ.25) LNC=7
0044          IF(AQL.EQ.40) LNC=14
0045          IF(AQL.EQ.65) LNC=25
0046          IF(AQL.EQ.100) LNC=40
0047      ENDIF
0048      IF(NZ.GE.80.AND.NZ.LE.129) THEN
0049          IF(AQL.EQ.6.5) LNC=2
0050          IF(AQL.EQ.10) LNC=4
0051          IF(AQL.EQ.15) LNC=7
0052          IF(AQL.EQ.25) LNC=14
0053          IF(AQL.EQ.40) LNC=24
0054          IF(AQL.EQ.65) LNC=42
0055          IF(AQL.EQ.100) LNC=68
0056      ENDIF
0057      IF(NZ.GE.130.AND.NZ.LE.199) THEN

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0059 IF (AQL.EQ.4.0) LNC=1
0060 IF (AQL.EQ.6.5) LNC=4
0061 IF (AQL.EQ.10) LNC=7
0062 IF (AQL.EQ.15) LNC=13
0063 IF (AQL.EQ.25) LNC=25
0064 IF (AQL.EQ.40) LNC=42
0065 IF (AQL.EQ.65) LNC=72
0066 IF (AQL.EQ.100) LNC=115
0067 ENDIF
0068 IF (NZ.GE.200.AND.NZ.LE.319) THEN
0069 IF (AQL.EQ.2.5) LNC=2
0070 IF (AQL.EQ.4.0) LNC=4
0071 IF (AQL.EQ.6.5) LNC=8
0072 IF (AQL.EQ.10) LNC=14
0073 IF (AQL.EQ.15) LNC=22
0074 IF (AQL.EQ.25) LNC=40
0075 IF (AQL.EQ.40) LNC=68
0076 IF (AQL.EQ.65) LNC=115
0077 IF (AQL.EQ.100) LNC=181
0078 ENDIF
0079 IF (NZ.GE.320.AND.NZ.LE.499) THEN
0080 IF (AQL.EQ.1.5) LNC=1
0081 IF (AQL.EQ.2.5) LNC=4
0082 IF (AQL.EQ.4) LNC=8
0083 IF (AQL.EQ.6.5) LNC=14
0084 IF (AQL.EQ.10) LNC=24
0085 IF (AQL.EQ.15) LNC=39
0086 IF (AQL.EQ.25) LNC=68
0087 IF (AQL.EQ.65) LNC=113
0088 IF (AQL.EQ.100) LNC=189
0089 ENDIF
0090 IF (NZ.GE.500.AND.NZ.LE.799) THEN
0091 IF (AQL.EQ.1.0) LNC=2
0092 IF (AQL.EQ.1.5) LNC=3
0093 IF (AQL.EQ.2.5) LNC=7
0094 IF (AQL.EQ.4.0) LNC=14
0095 IF (AQL.EQ.6.5) LNC=25
0096 IF (AQL.EQ.10) LNC=40
0097 IF (AQL.EQ.15) LNC=63
0098 IF (AQL.EQ.25) LNC=110
0099 IF (AQL.EQ.40) LNC=181
0100 ENDIF
0101 IF (NZ.GE.800.AND.NZ.LE.1249) THEN
0102 IF (AQL.EQ.0.65) LNC=2
0103 IF (AQL.EQ.1.0) LNC=4
0104 IF (AQL.EQ.1.5) LNC=7
0105 IF (AQL.EQ.2.5) LNC=14
0106 IF (AQL.EQ.4.0) LNC=24
0107 IF (AQL.EQ.6.5) LNC=42
0108 IF (AQL.EQ.10) LNC=68
0109 IF (AQL.EQ.15) LNC=105
0110 IF (AQL.EQ.25) LNC=181
0111 ENDIF
0112 IF (NZ.GE.1250.AND.NZ.LE.1999) THEN
0113 IF (AQL.EQ.0.40) LNC=2
0114 IF (AQL.EQ.0.65) LNC=4
IF (AQL.EQ.1.0) LNC=7

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0115      IF (AQL.EQ.1.5) LNC=10
0116      IF (AQL.EQ.2.5) LNC=24
0117      IF (AQL.EQ.4.0) LNC=40
0118      IF (AQL.EQ.6.5) LNC=69
0119      IF (AQL.EQ.10) LNC=110
0120      IF (AQL.EQ.15) LNC=169
0121      ENDIF
0122      IF (NZ.GE.2000.AND.NZ.LE.3149) THEN
0123          IF (AQL.EQ.0.25) LNC=2
0124          IF (AQL.EQ.0.40) LNC=4
0125          IF (AQL.EQ.0.65) LNC=8
0126          IF (AQL.EQ.1.0) LNC=14
0127          IF (AQL.EQ.1.5) LNC=22
0128          IF (AQL.EQ.2.5) LNC=40
0129          IF (AQL.EQ.4.0) LNC=68
0130          IF (AQL.EQ.6.5) LNC=105
0131          IF (AQL.EQ.10) LNC=181
0132      ENDIF
0133      IF (NZ.GE.3150.AND.NZ.LE.4999) THEN
0134          IF (AQL.EQ.0.15) LNC=1
0135          IF (AQL.EQ.0.25) LNC=4
0136          IF (AQL.EQ.0.40) LNC=8
0137          IF (AQL.EQ.0.65) LNC=14
0138          IF (AQL.EQ.1.0) LNC=24
0139          IF (AQL.EQ.1.5) LNC=38
0140          IF (AQL.EQ.2.5) LNC=67
0141          IF (AQL.EQ.4.0) LNC=111
0142          IF (AQL.EQ.6.5) LNC=186
0143      ENDIF
0144      IF (NZ.GE.5000.AND.NZ.LE.7999) THEN
0145          IF (AQL.EQ.0.10) LNC=2
0146          IF (AQL.EQ.0.15) LNC=3
0147          IF (AQL.EQ.0.25) LNC=7
0148          IF (AQL.EQ.0.40) LNC=14
0149          IF (AQL.EQ.0.65) LNC=25
0150          IF (AQL.EQ.1.0) LNC=40
0151          IF (AQL.EQ.1.5) LNC=63
0152          IF (AQL.EQ.2.5) LNC=110
0153          IF (AQL.EQ.4.0) LNC=181
0154      ENDIF
0155      IF (NZ.GE.8000.AND.NZ.LE.12499) THEN
0156          IF (AQL.EQ.0.065) LNC=2
0157          IF (AQL.EQ.0.10) LNC=4
0158          IF (AQL.EQ.0.15) LNC=7
0159          IF (AQL.EQ.0.25) LNC=14
0160          IF (AQL.EQ.0.40) LNC=24
0161          IF (AQL.EQ.0.65) LNC=42
0162          IF (AQL.EQ.1.0) LNC=68
0163          IF (AQL.EQ.1.5) LNC=105
0164          IF (AQL.EQ.2.5) LNC=181
0165      ENDIF
0166      IF (NZ.GE.12500.AND.NZ.LE.19999) THEN
0167          IF (AQL.EQ.0.040) LNC=2
0168          IF (AQL.EQ.0.065) LNC=4
0169          IF (AQL.EQ.0.10) LNC=7
0170          IF (AQL.EQ.0.15) LNC=13
0171          IF (AQL.EQ.0.25) LNC=24

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0172      IF (AQL.EQ.0.40) LNC=40
0173      IF (AQL.EQ.0.65) LNC=69
0174      IF (AQL.EQ.1.0) LNC=110
0175      IF (AQL.EQ.1.5) LNC=167
0176      ENDIF
0177      IF (NZ.GE.20000.AND.NZ.LE.31499) THEN
0178          IF (AQL.EQ.0.025) LNC=2
0179          IF (AQL.EQ.0.040) LNC=4
0180          IF (AQL.EQ.0.065) LNC=8
0181          IF (AQL.EQ.0.10) LNC=14
0182          IF (AQL.EQ.0.15) LNC=22
0183          IF (AQL.EQ.0.25) LNC=40
0184          IF (AQL.EQ.0.40) LNC=68
0185          IF (AQL.EQ.0.65) LNC=115
0186          IF (AQL.EQ.1.0) LNC=181
0187      ENDIF
0188      IF (NZ.GE.31500.AND.NZ.LE.49999) THEN
0189          IF (AQL.EQ.0.015) LNC=1
0190          IF (AQL.EQ.0.025) LNC=4
0191          IF (AQL.EQ.0.040) LNC=8
0192          IF (AQL.EQ.0.065) LNC=14
0193          IF (AQL.EQ.0.10) LNC=24
0194          IF (AQL.EQ.0.15) LNC=38
0195          IF (AQL.EQ.0.25) LNC=67
0196          IF (AQL.EQ.0.40) LNC=111
0197          IF (AQL.EQ.0.65) LNC=186
0198      ENDIF
0199      IF (NZ.GE.50000) THEN
0200          IF (AQL.EQ.0.010) LNC=2
0201          IF (AQL.EQ.0.015) LNC=3
0202          IF (AQL.EQ.0.025) LNC=7
0203          IF (AQL.EQ.0.040) LNC=14
0204          IF (AQL.EQ.0.065) LNC=25
0205          IF (AQL.EQ.0.10) LNC=40
0206          IF (AQL.EQ.0.15) LNC=63
0207          IF (AQL.EQ.0.25) LNC=110
0208          IF (AQL.EQ.0.40) LNC=181
0209          IF (AQL.EQ.0.65) LNC=301
0210      ENDIF
0211      CONTINUE
0212      RETURN
0213      END

```

10

Program PROBS1.FOR

```

0001      SUBROUTINE PROBS1(NN,P,Q,BXLEC)
0002      C *****
0003      C THIS SUBROUTINE COMPUTES CUMULATIVE BINOMIAL
0004      C PROBABILITIES
0005      C *****
0006      INTEGER C
0007      DOUBLE PRECISION SUMLOG
0008      C
0009      COMMON/BLK7/SUMLOG(4000)
0010      COMMON/BLK8/N
0011      C
0012      Q=1.-P
0013      C *****
0014      C BINOMIAL PROB. WHEN C=0
0015      C *****
0016      CSUMS=Q**NN
0017      IF (C.LE.0) GOTO 45
0018      C *****
0019      C AVOID RECOMPUTING SUMLOG(I)'S ALREADY IN MEMORY
0020      C *****
0021      IF (N-NN) 10,25,25
0022      10 N=N+1
0023      C *****
0024      C COMPUTE N SUMLOGS-EQUIVALENT TO N-FACTORIAL
0025      C *****
0026      IF (M.GT.1) GOTO 15
0027      SUMLOG(1)=0.
0028      IF (NN.LE.1) GOTO 25
0029      M=2
0030      15 DO 20 I=M,NN
0031          SUMLOG(I)=DLOG10(DFLOAT(I))+SUMLOG(I-1)
0032      20 CONTINUE
0033      C *****
0034      C COMPUTE C SUMS-EQUIVALENT TO SSUM OF PROB.COMPIN.
0035      C I.E. CUMULATIVE BINOMIAL DISTRIBUTION COMPUTATION
0036      C *****
0037      25 IF (NN.GT.N) N=NN
0038      C *****
0039      C DETERMINE BEST NUMBER HANDLING LOOP
0040      C *****
0041      IF (NN.GT.300) GOTO 35
0042      DO 30 K=1,C
0043          CSUMS=10.**((SUMLOG(NN)-SUMLOG(NN-K)-SUMLOG(K))
0044              *P**K*Q**(NN-K)+CSUMS
0045      30 CONTINUE
0046      GOTO 45
0047      C *****
0048      C LOOP FOR LARGE EXPONENTS
0049      C *****
0050      35 DO 40 K=1,C
0051          CSUMS=10.**((SUMLOG(NN)-SUMLOG(NN-K)-SUMLOG(K)
0052              +K*DLOG10(DBLE(P))+(NN-K)*DLOG10(DBLE(Q)))+CSUMS
0053      40 CONTINUE
0054      C
0055      45 BXLEC = CSUMS
0056      RETURN
0057      END

```

Program PROBD1.FOR

```

0001      SUBROUTINE PROBD1(N1,N2,P,DPROB)
0002      C*****
0003      C      THIS SUBROUTINE COMPUTES DOUBLY PROBABILITIES FOR
0004      C      COMPUTING SECOND SAMPLE NUMBER OF DOUBLY SAMPLING NUMBER
0005      C*****
0006      COMMON/BLK6/C1,C2
0007      INTEGER C1,C2,R1
0008      C
0009      IF(K.EQ.1) CALL PROBS1(N1,P,C1,BXLEC)
0010      IF(K.EQ.2) CALL PROBS2(N1,P,C1,BXLEC)
0011      DPROB=BXLEC
0012      TEMP=BXLEC
0013      NTEMP=C1+1
0014      KTEMP=R1+1
0015      DO 10 IX=NTEMP,KTEMP
0016          I=IX
0017          J=C2+1
0018          IF(K.EQ.1) CALL PROBS1(N1,P,I,BXLEC)
0019          IF(K.EQ.2) CALL PROBS2(N1,P,I,BXLEC)
0020          PROB1=BXLEC-TEMP
0021          TEMP=BXLEC
0022          IF(K.EQ.1) CALL PROBS1(N2,P,J,BXLEC)
0023          IF(K.EQ.2) CALL PROBS2(N2,P,J,BXLEC)
0024          DPROB=DPROB+(PROB1*BXLEC)
0025      10 CONTINUE
0026      C
0027      RETURN
0028      END

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END

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